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APRIL 1947

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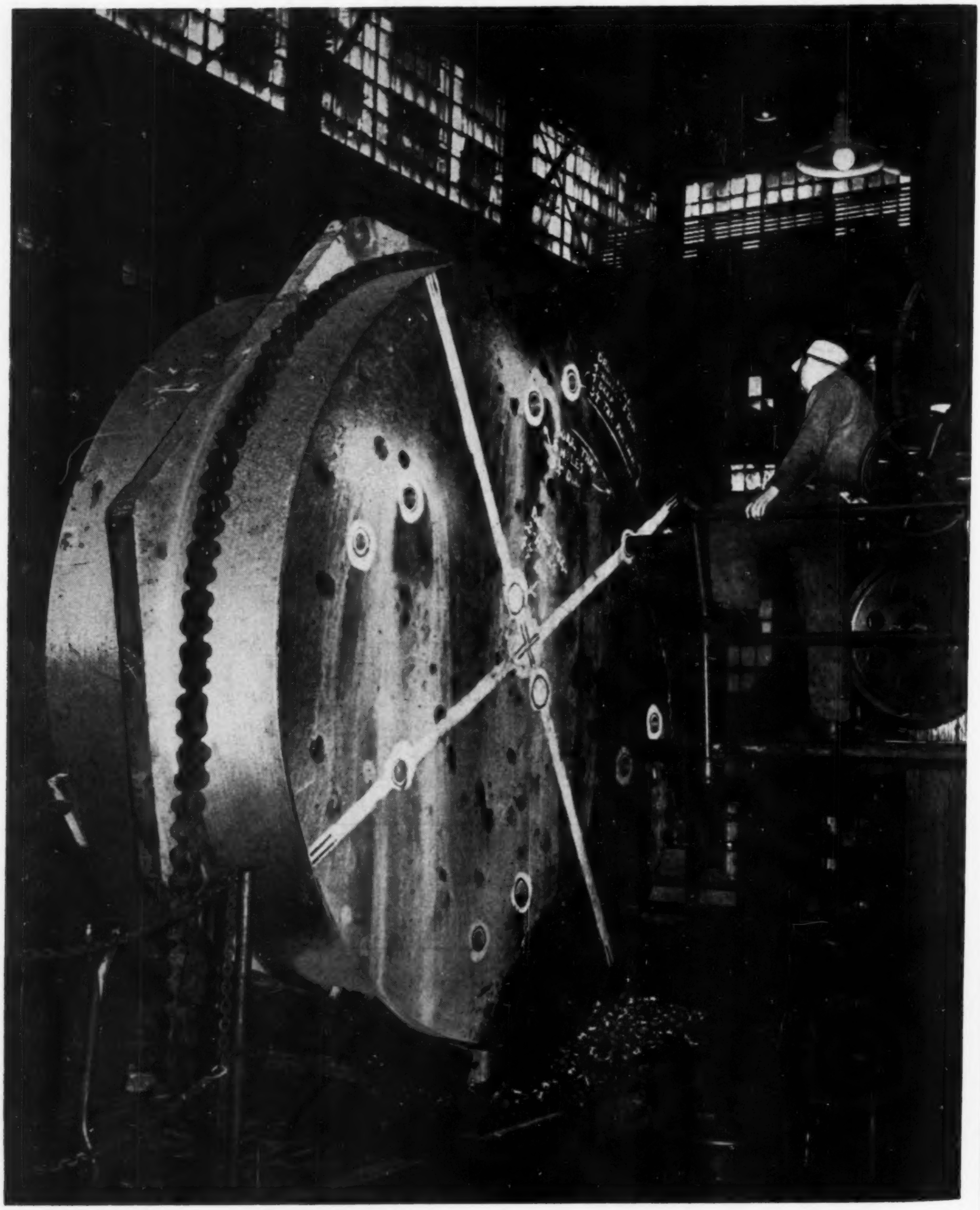

A Circular Pole Piece of the Cyclotron Magnet

(Built for the Navy and University of Rochester by a subsidiary of United States Steel Corporation, this pole piece is here being drilled for the bolts which will hold it together. The magnet pole pieces are about 130 inches in diameter as contrasted with the 26-inch diameter of the University's present cyclotron.)

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GEORGE A. STETSON, *Editor*

Employer Practices

ENGINEERS, particularly if they are recent graduates or still in the colleges, will welcome the opportunity to study the report of a survey of employer practice regarding engineering graduates which will be found in this issue. The report, which is based on a preliminary survey, was prepared by a subcommittee of the Engineers Joint Council's Committee on the Economic Status of the Engineer. It is based on replies received from 104 employers in 19 fields of industry, with 2,000,000 employees, of whom 30,000 are engineers.

During and after the war many young engineers were forced to give more attention to their economic status and their employment conditions than to professional development. Their salaries, in many cases, did not advance as rapidly as other wage rates and the cost of living. In many industries young engineers were face to face with the unionization problem. What aid and guidance could their engineering societies give them? Each society attempted to answer this question for its own conditions; but through the Engineers Joint Council factual studies of these questions have been in progress for the benefit of all. The survey of employer practice regarding engineering graduates is one of these.

The general observations on the survey reported in this issue reveal practices to be about what one would expect them to be. But the survey does make it possible to compare these practices by industries. For example, when it is reported that 43 per cent of the employers hire more than half of their new engineer employees after one or more years' experience with other employers the impression is confirmed that many employers are not doing their share when it comes to breaking in the young graduate. Only 50 per cent reported that they make special provision for the professional development of graduate engineer employees. Not to make such a provision would seem to be a shortsighted policy as it shows an indifference to making the best use of potential man power and is likely to turn the best graduates away from industries which thus neglect their young engineers.

Replies to the question on the bases on which engineering employees are selected are about as would be expected, with "personality" heading the list. Scholastic record and promise hold deservedly high positions and the salary requested is, as it should be, the least important consideration. The Committee which prepared the report succinctly described the desirable engineering graduate as having a "well-rounded-out individuality with a good personality, qualified by education and experience to make a good engineer."

Somewhat less to be expected is the fact that 83 per cent of employers replying consider present engineering education satisfactory. Those who criticized it pointed to lack of fundamentals (physical sciences and mathematics), inarticulateness in speech and writing, lack of education in humanities, of drafting and design, of knowledge of economics and business, and of operation and production, as justification of their complaints. It will be noted that high in this list are deficiencies the colleges are best able to overcome; while low in the list are those which are most effectively cured by experience in industry.

A median monthly starting salary of $207 (low, $150 and high, $250) is probably already outdated, as indications are that current rates are already higher. The figures reported are nearly a year old now and the tendency to raise starting salaries has not yet been reversed.

One of the most surprising features of the survey is the relatively low percentage of increase of engineering employees estimated as needed over the next four years. The rate of 8 per cent per year contrasts markedly with that of 17 per cent reported by the Compton Committee last summer and is probably much lower than most engineers and educators would select. Undergraduate engineering enrollment in 130 colleges in the United States numbered 97,000 regular and 99,000 veteran students, as of November, 1946, to say nothing of more than 1200 women. This enrollment is, of course, extraordinary, but there is no doubt that a considerable increase in the number of college graduates is to be looked for in the future. This is accompanied by increased enrollment of graduate engineering students which, in November, 1946, showed about 13,000 working for the master's and about 1100 working for the doctor's degree. It is apparent that engineering colleges can afford to establish and maintain high standards of quality and performance for engineering students from which both industry and the engineering profession will derive great benefit.

In preparing the summary table of significant data from its survey the Committee arranged the industries reporting in groups in the order of the percentage of engineers to total employees. This arrangement brings out some interesting comparisons which engineering students seeking employment will find illuminating and which the industries themselves may well ponder. Excluding the colleges (a group by themselves) it is apparent that in groups for which these percentages are highest, the engineering graduate will find the most favorable opportunities for employment. Group D of the table, which represents industries in which engineering graduates are less than one per cent of all employees,

contains some industries in which engineering is and should be of vital importance. Yet of this group only 65 per cent considered the engineer's role in the development of the company "very important," only 45 per cent thought that engineering graduates had better potential opportunities than other employees of comparable education, and only 42 per cent felt that the opportunities for the advancement of engineering graduates was greater than ever. The engineering schools might well look into the reasons for these relatively low percentages and get together with the industries concerned with a view to improving relationships and understanding.

It is hoped that company officials, particularly those representing industries in which relatively few engineering graduates are now employed, will study the survey and ask themselves if their own practices are in line with those of other employers in the same or different industries. The present survey was limited to the proportions of a pilot survey. If a more extensive survey is conducted later in the year as the committee recommends, more reliable and more representative data will be available. For their own good, employers are urged to study the present data and co-operate wholeheartedly should they receive questionnaires covering the larger survey.

A.S.M.E. Transactions

LAST month attention was directed in these pages to the reader-interest survey being conducted by MECHANICAL ENGINEERING. Although no similar survey of A.S.M.E. Transactions is at present contemplated, it would be helpful to know what A.S.M.E. members think about the quality and adequacy of service of that publication. The question is important because of changing conditions. Publications are a major item of expense to the Society. Printing costs are continually rising. The volume of material presented in the form of papers is continually increasing. The number and diversity of the interests of members, represented in the growth of professional divisions, technical committees, and activities carried on jointly with other societies, is constantly growing. All of these factors affect publications and are the source of perplexing questions that should be answered. But before answers to these questions can be formulated it is necessary to understand the nature and purpose of Society publications.

The periodical publications of the Society, as distinct from special publications such as codes, standards, books, and pamphlets, are designed to meet three general needs: (1) News of the Society and its activities; (2) articles of general interest covering a wide range of subject matter aimed at keeping members up to date on advances in technical, professional, and related fields; and (3) technical papers that are of permanent reference value. MECHANICAL ENGINEERING attempts to meet the first two of these needs: Transactions, including the *Journal of Applied Mechanics*, the third.

Present concern is with the Transactions, which has been published ever since the formation of the Society. Prior to 1927 every member received annually a bound volume of Transactions. Since 1927, when Transactions began appearing in periodical form, only members who have paid extra for it have received the bound volume. For reference and library use, the bound volume is convenient and preferable. The average member apparently finds the monthly issues best for his use, as it has never been necessary to bind more than 1500 copies to satisfy the demands of members, libraries, and other purchasers. At least one other society of comparable size satisfies its needs for its bound transactions with approximately the same number of copies.

The question naturally arises, then, as to whether the monthly issues of the Transactions are meeting the need for which they were intended. Evidence is strong that there is waste and extravagance in the present method of publication and distribution. How can this waste be cut and service to members be increased?

It is the experience of engineering societies having large and diversified memberships that about 5 per cent of the members find any technical paper of transactions type of immediate value to them. This is not a reflection on the papers or the authors. It is merely evidence of the fact that such papers are used by specialists. In any one field the number of specialists is small. If a scheme could be devised whereby every member who had use for a given paper could get a copy promptly and without much effort and all papers could be available for library use, the Society might save a considerable portion of its publication expense or publish more papers for the same amount of money.

Some scientific societies offer no complete publication service. Papers are abstracted and readers can order microfilm copies of the original manuscript and use a reading machine. An alternative is to order photostat copies or enlargements of the microfilm.

Another scheme is to prepare mimeographed or photolithographic copies of the author's manuscript and to publish abstracts in the society's journal. Members who wish the complete paper can order copies by mail.

In all these schemes there is no provision for a permanent "transactions" for library use. To provide annual bound volumes for libraries it would be possible to print all papers, publish abstracts of them in the society's journal, and rely on members to order printed copies of papers they wish to have in complete form.

Segregation of papers into separate periodicals, each devoted to a general field of interest, such as the *Journal of Applied Mechanics*, is another means by which it would be possible to provide a member with papers relating to his specialty. This scheme was tried in 1927 when the papers of each A.S.M.E. professional division were issued in separate pamphlets. A member received only the pamphlets of the three divisions in which he was registered. After a few years' trial, the scheme was abandoned in favor of the monthly Transactions which were sent to all members. This is the plan in effect at the present time.

It would be helpful if A.S.M.E. members would think about the present method of publishing and distributing Transactions and suggest other plans.

RECENT DEVELOPMENTS IN GAS TURBINES

By DR. ADOLPH MEYER

DIRECTOR AND CHIEF CONSULTING ENGINEER, BROWN BOVERI & CO., LTD., BADEN, SWITZERLAND. MEMBER A.S.M.E.

A FRIENDLY fate and the great efforts of all concerned enabled Switzerland to keep out of war and to pursue its peacetime endeavors while most other countries had to work strenuously and nearly exclusively for the war.

Swiss firms engaged in the development of the gas turbine at the outbreak of the war felt that this privilege imposed on them an obligation and continued research, development, design, and manufacture of prototypes under steadily rising difficulties throughout the war. One of these difficulties was the scarcity of creep-resistant materials for blades and rotors working at high temperature.

Two methods which allow the use of higher temperatures without the use of better materials will be described in this paper. They have been developed with perseverance and expense, one by Sulzer Bros., Winterthur, and the other by Brown Boveri, Baden. Both methods have the common feature of using two-stage processes in which the first stage is not a gas turbine.

In a two-stage combustion turbine, Fig. 1, with 1100 F before

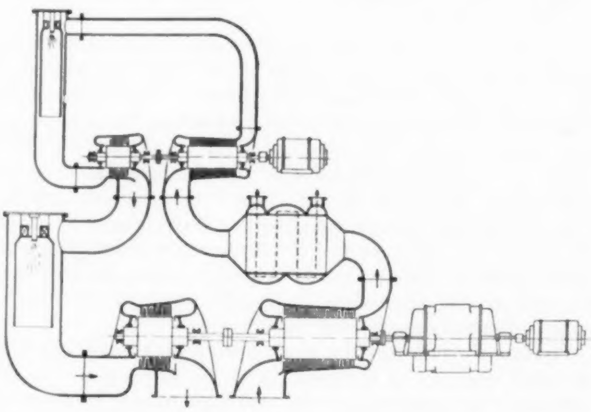


FIG. 1 DIAGRAM OF TWO-STAGE GAS TURBINE SET

each stage, the compressors take 60 per cent of the power which the two gas turbines produce. The first turbine produces compressed air only and has no net output at all.

The higher the efficiency of the compressor, the less power it takes from the gas turbine and the more remains as net output.

It was therefore proposed long ago to compress the air in the high-pressure stage separately, with the highest possible efficiency, by using a Diesel-engine-driven piston compressor, thus also doing away with the high-pressure combustion chamber.

SULZER FLOATING-PISTON POWER GAS GENERATOR

The form of a floating-piston machine as built by Junkers

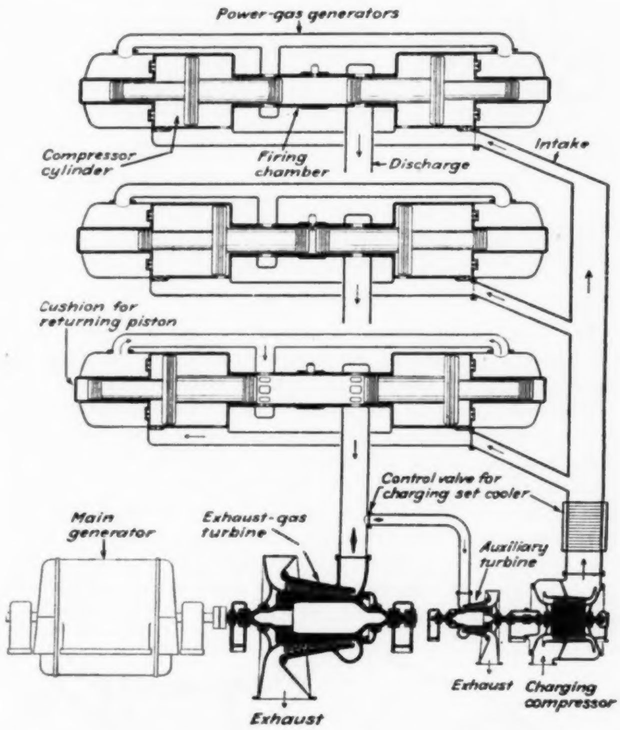


FIG. 2 THREE SULZER FLOATING-PISTON ENGINES WITH GAS TURBINE

in Germany, Pescara in France, and Sulzer Bros. in Switzerland, has been successfully developed for this purpose by the last-named firm. Three floating-piston engines combined with two gas turbines and two axial compressors give a net output of 7000 hp, Fig. 2. The smaller turboset is used for supercharging the piston compressors which provide the air, further compressed, for the opposed-floating-piston Diesel engines. The exhaust gases of this engine flow to the main gas turbine at the left which produces the net output. Such a set may give an over-all efficiency of more than 40 per cent as compared with 34 per cent which Brown Boveri guaranteed on a two-stage 27,000-kw set designed and now being built for a Swiss power station. This is the highest efficiency ever obtained from a gas-turbine set.

The Sulzer high-pressure set profits from the high efficiency of the Diesel drive which is due to the high initial temperature with which the Diesel process works. Now it is well known that the Diesel could not work, in spite of its water cooling, were it not for the fact that one and the same cylinder has two functions. It works alternately as compressor and as a combustion-expansion machine. If it had an explosion every stroke, it would probably not stand the higher heat stresses.

Several attempts have been made to obtain similar conditions

Contributed by the Oil and Gas Power Division and presented at the Annual Meeting, New York, N. Y., December 2–6, 1946, of The American Society of Mechanical Engineers.

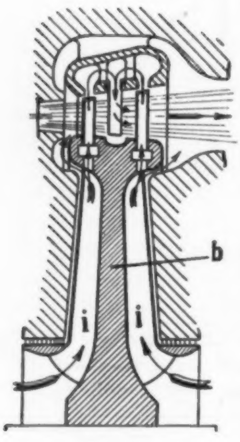


FIG. 3

in a rotating machine. Brown Boveri, for instance, obtained a patent some 20 years ago to use the hollow blades of an impulse gas turbine to compress air by centrifugal action, so as to cool the disk and the blades and to heat the air simultaneously, Fig. 3. Such machines were built after the first world war on license by a Berlin firm for some special purposes. The heat transmission of the two mediums, streaming with very high velocities inside and outside the blades, proved to be very high and caused such great losses that the combined efficiency was very poor.

A much more interesting machine of this kind, called "comprex," has been incorporated in the design of the power set of a new gas-turbine locomotive which is now on the test bed of Brown Boveri in Switzerland.

THE COMPREX

The comprex was invented in 1940 by Claude Seippel, then chief of the gas-turbine department, today, my successor as the director of the thermal departments of Brown Boveri.

The name comprex originates from the fact that the same rotating machine compresses air and expands gas. This combined function is not new and is not especially interesting in itself, as it is performed by any supercharger for Diesel or gasoline engines. The special feature and merit of the comprex is that compression and expansion take place in the same rotor just as they do in a Diesel cylinder and with the same result, i.e., the rotor is subjected to the average temperature of the averages of the entrance and exit temperatures of the two processes, compression and expansion. Thus, for instance, if the gas temperature before the expansion in the high-pressure stage is 1800 F and before the low-pressure stage is 1100 F, the mean temperature of expansion in the comprex is 1450 F. If the air temperature before the compression in the comprex is 400 F and after the compression is 600 F, the mean temperature of compression is 500 F. The mean temperature of the two processes, both of which take place alternately in the rotor of the comprex, is therefore (1450 + 500)/2 or 975 F, and this is the temperature of the rotor. As about 3000 cells per second pass from compression to expansion, the temperature differences in the rotor per revolution are less than 4 F and the depth to which those changes penetrate into the material is only about 0.004 in.

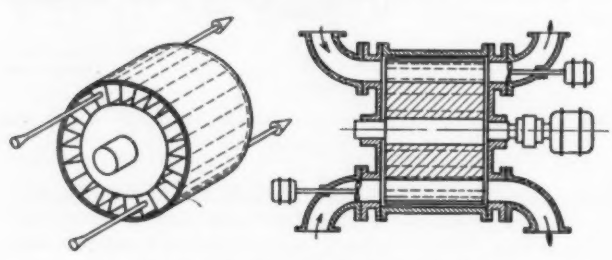


FIG. 4 CELL ROTOR AND DIAGRAM, COMPREX

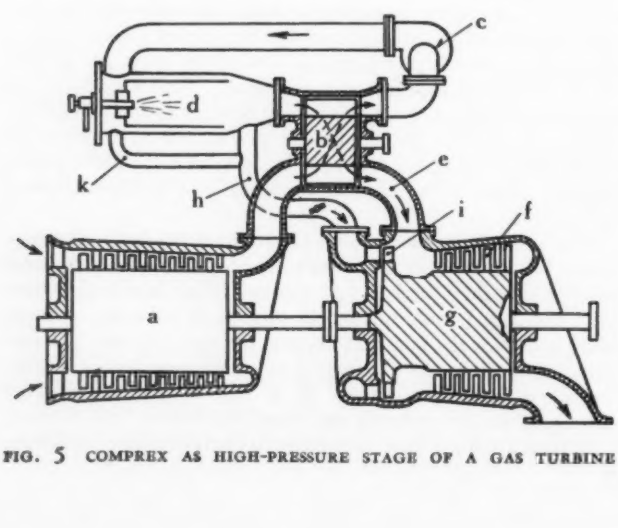


FIG. 5 COMPREX AS HIGH-PRESSURE STAGE OF A GAS TURBINE

Let us see how this is arrived at.

The rotor of the comprex consists of a number of cells arranged around a shaft as shown in Fig. 4. These cells carry, alternately, air to be compressed and gas to be expanded, both flowing in the same direction as shown in Fig. 5, which represents the comprex as the second stage of a gas turbine.

Atmospheric air enters the axial compressor *a*, is compressed, and flows to the lower part of comprex *b*, where it enters the cells which, by rotation, bring it to the upper part and compress it to a higher pressure on the way. It is then blown into a combustion chamber *d* by blower *c*, from where it flows into the cell of the comprex, which at the time is on the top, and helps to force the fresh air into blower *c*. The gases are then brought down to the exhaust *e* of the comprex and are expanded on the way in such a manner that they help to compress the fresh air. They then enter the reaction part *f* of gas turbine *g* where they expand to atmospheric pressure, doing useful work.

The way the air is compressed and how the gases are expanded are explained later.

I want to point out first that the cells of the comprex can hold only the same volume of hot air for expansion as that of the compressed air which they brought up. But because of the temperature rise in the combustion chamber, there is an excess volume of hot gas that must be taken care of. This excess gas, which has the pressure and the temperature of the upper stage, is carried through pipe *h* to a separate impulse stage *i* after having been mixed with relatively cold air introduced from the upper part of the combustion chamber by pipe *k* and cooled to such an extent that this excess gas will have the same temperature when leaving the nozzle of the impulse stage as the gas coming from the comprex.

Tests on the first machine made during 1941 to 1943 showed the total efficiency of the comprex to be 69 per cent. As the efficiencies of compression and expansion cannot be measured separately, we may credit each process with 83 per cent. The pressure ratio obtainable proved to be up to 3 to 1.

As a result of these tests it was decided to use a comprex as a second stage for a gas-turbine locomotive, having materially the same turbine and compressor as our first locomotive of 2200 hp at the generator coupling. We expect from this first application of the comprex a power increase of 80 per cent, from 2200 hp to 4000 hp at the coupling of the generator, and an increase in efficiency of about 25 per cent, from 18 to 22.5 per cent.

From Fig. 6, drawn to scale, the length of the comprex in relation to the rest of the power set may be seen.

And now as to the way it works. Fig. 7 shows the different phases of compression and expansion that take place successively in every cell of the rotor at every revolution.

As air is streaming through one of the cells from left to right (top position), the right end toward which it is streaming is suddenly closed. A pressure wave, thus produced, starts at the closed end and proceeds with the velocity of sound toward

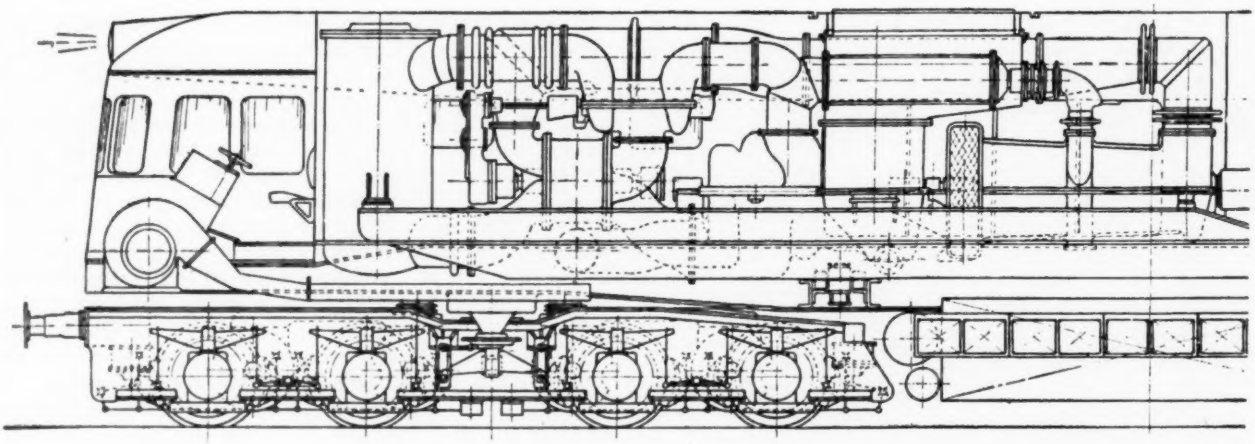


FIG. 6 GAS TURBINE SET OF 4000 HP, WITH COMPREX, IN LOCOMOTIVE LAYOUT

the open end from right to left, which end is also closed when the wave reaches it. This corresponds to what happens in the well-known hydraulic ram, so we may call the phenomenon a pneumatic ram. The pressure rise depends on the specific weight of the gas, its speed, and the rapidity of the closing operation. In Fig. 7*b* this pressure rise is about 50 per cent of the pressure P_1 with which the air entered the cell. It is much higher than the pressure difference corresponding to the speed of the air.

The closing and opening of the cells is produced by their rotation between the fixed end shields of the comprex, which are provided with two openings on each side through which air and gas enter and escape.

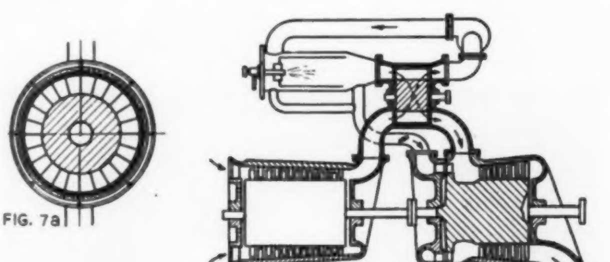


FIG. 7a

FIG. 7

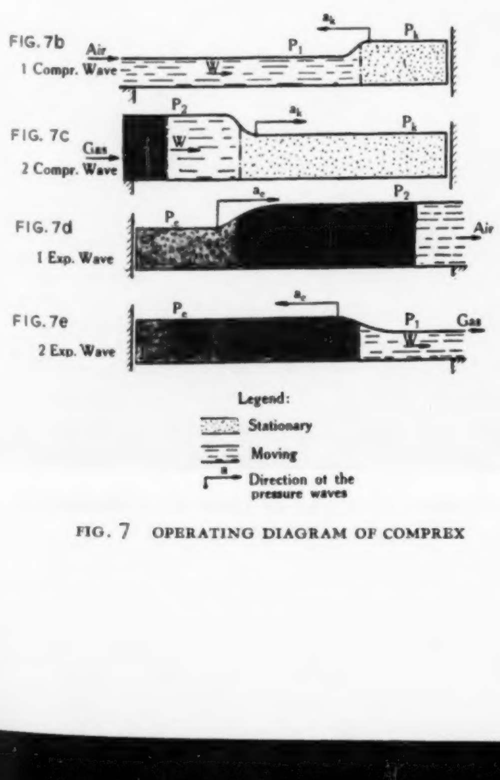


FIG. 7 OPERATING DIAGRAM OF COMPREX

When a cell is filled with compressed air as just explained, it travels to the upper part of the comprex where the second phase of compression takes place, according to Fig. 7*c*. The air pressure in the cell P_k is still below that of the combustion chamber, so that when the left-hand side of the cell is opened, the right-hand side being still closed, a gas piston rushes in, compressing the air with a second pressure wave to the final pressure P_2.

As soon as the pressure wave gets to the right-hand end, this is opened and the whole content of the cell is in movement, the air being scavenged by the gas on one side and a blower on the other.

Now the cell on the left side is closed. As the gas is still in movement, an expansion wave occurs, Fig. 7*d*, with a corresponding reduction in pressure. When the wave reaches the right-hand end of the cell, this end is closed too and the enclosed gas, at reduced pressure, travels in the cell down toward the exhaust pipe.

Now comes the last pressure drop of the gas, Fig. 7*e*. The cell opens at the right and the gas expands further, going through the low-pressure portion of the gas turbine.

As the left-hand end is still closed, another expansion wave sets in, going from right to the left. The result of this wave is a kind of Kadenacy effect which reduces the pressure in the cell further, thus preparing it for the reception of a new fresh-air piston. Then the air entrance at the left is opened as soon as the expansion wave reaches it. The air scavenges the gas until the cell is filled with air rushing from left to right.

Now the right-hand side is closed and a new cycle begins and proceeds in the manner already described, Fig. 7*b*.

PROPERTIES OF THE COMPREX

The comprex can work with given materials at temperatures which are 350 to 700 F higher than those of any gas turbine. Even with an initial temperature of 2000 F and 1100 F in the second stage the final average is 1025 F, which is quite admissible for today's materials.

Owing to the rapid motion of the moving cells through the stationary stages of compression and expansion the temperature differences which occur are only of the order of less than 4 F and penetrate the material less than 0.004 in. The output is continuous, as at 6000 rpm, with 30 cells in the rotor, approximately 3000 cells pass each second.

SIZE OF GAS TURBINES

I have been asked what size the largest and the smallest

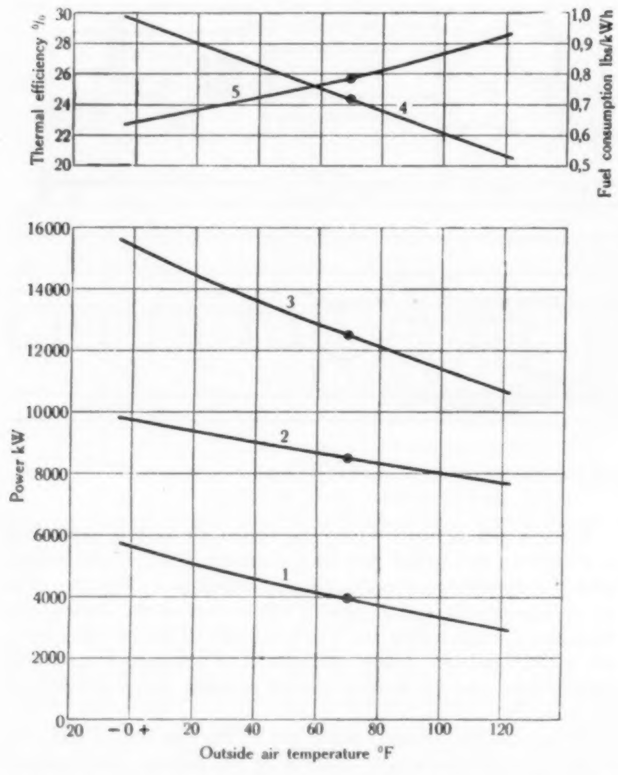


FIG. 8 OUTPUT AND EFFICIENCY AT VARIOUS AIR TEMPERATURES

gas-turbine set will probably be. As I am strongly opposed to prophesying in technical matters, having been caught at it already several times, I prefer just to state of what size they are today.

The largest size, to my knowledge, is a 27,000-kw set which has been ordered by the Swiss North-East Power Company to furnish supplementary power to their grid in wintertime, when the output of their low-head hydraulic plants is considerably reduced by freezing. As this is a new and interesting application, a few words may be said about it before describing the turbine machinery proper. Until now, river water power has been supplemented in winter by high-head water power, using artificial lakes as storage basins. This kind of power is expensive, compared to the power it has to supplement, because of the high cost of the dams which provide the artificial lakes for storage. Furthermore, such installations often necessitate the expropriation of whole villages and their arable lands. This adds considerably to the cost and also to the construction time, which may be as long as seven years. As these plants have to be built where topographic conditions are propitious, they are usually far from the centers of consumption and require long and expensive transmission lines, while gas-turbine plants, which need very little water, can be located in the very centers of load or in already existing centers of distribution.

It must be mentioned, however, that this is in a great measure due to the special application, i.e., the production of winter power. As seen from diagram Fig. 8, the increase in power from a normal temperature of 70 F to the temperature of 40 F, which, in our case, is the mean temperature from November to March, is about 30 per cent; the increase in efficiency is 5 per cent. Both of these increases help to decrease cost per kilowatthour, one on the investment and one on the operating side.

This fact made it also possible to use existing machinery; the 13,000-kw set is identical with a 10,000-kw set built for Peru for a higher ambient temperature, while the 27,000-kw set is merely a duplication of this set, with a double-ended gas turbine and a low-pressure compressor having two stages in parallel, as seen in Fig. 9. The size of those turbines is of course quite considerable, owing to the fact that, at initial temperatures of 1110 F for the smaller high-pressure unit and 1020 F for the much larger low-pressure cylinder, these two machines have to give about 65,000 kw to produce the net output of 27,000 kw. With those initial temperatures and an ambient temperature of 41 F, an efficiency of 34 per cent is expected.

Fig. 10 shows the high-pressure turbine of the 13,000-kw unit; and Fig. 11, the complete set without the reheaters.

The 13,000-kw set is to be ready for service in the fall of

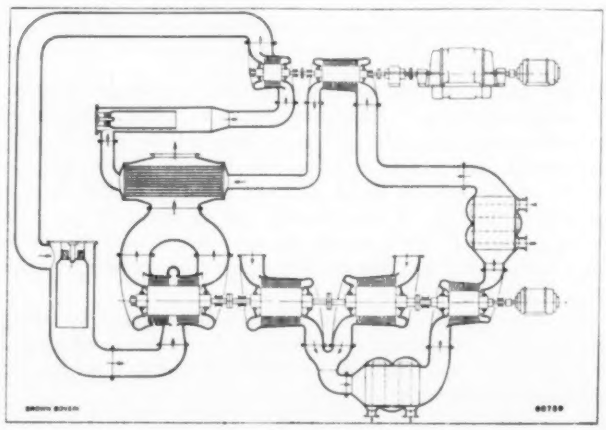


FIG. 9 DIAGRAM OF 27,000-KW GAS-TURBINE SET

FIG. 10 LOWERING THE COVER ON 13,000-KW HIGH-PRESSURE GAS TURBINE

1947, the 27,000-kw set in the fall of 1948.

The smallest gas turbine is probably a supercharger built for wood-gas-driven automotive engines which were largely used in Switzerland during the war when no gasoline was available. It serves to supercharge engines from 60 to 100 hp by about 40 per cent.

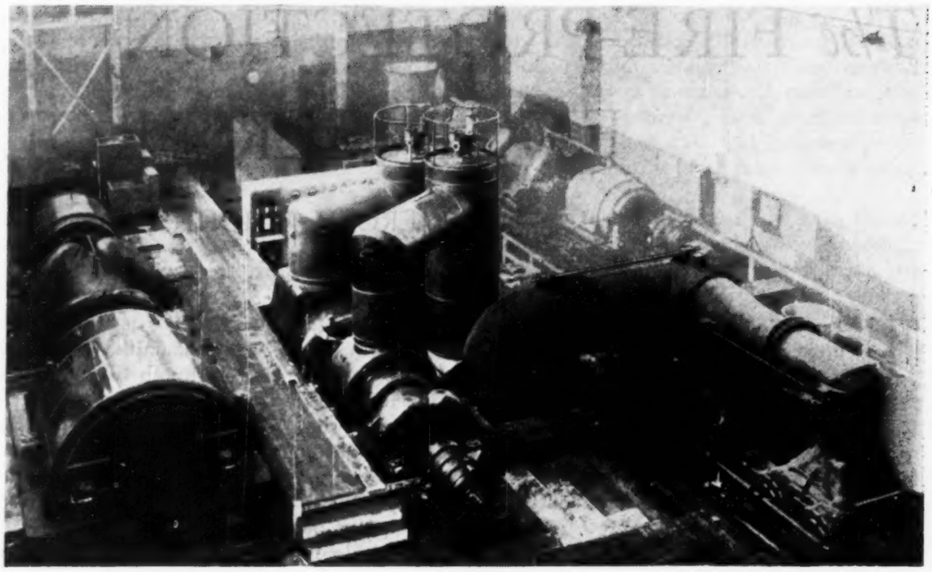


FIG. 11 13,000-KW SET ON TEST FLOOR

The impellers of the gas turbine and the compressor are 4 in. in diameter and run at 50,000 rpm. Fig. 12 shows the rotor. The impellers of turbine and blower are nearly alike and are mounted overhung, back to back. In the gas-turbine impeller, the flow of the gases is from the outside inward (centripetal turbine), while the blower is of normal centrifugal design. The lubrication at 50,000 rpm proved to be somewhat difficult, but the two disks, seen in Fig. 12 between the two ball bearings, solved the problem. They create a small vacuum, suck in oil from a tank at the bottom, and throw it out again on the top, from whence it flows through the bearings back to the tank. The next larger size with an impeller of 4.5 in. diameter for supercharging Diesels up to 160 hp, is shown in Fig. 13, together with a rotor for supercharging a Diesel of 4000 hp.

In Fig. 14 the small rotor is carried by a little Swiss girl who wishes you a happy 1947.

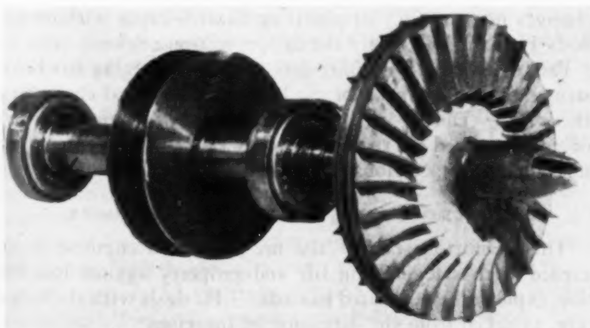


FIG. 12 SMALLEST SUPERCHARGER ROTOR (60–100-HP ENGINES)

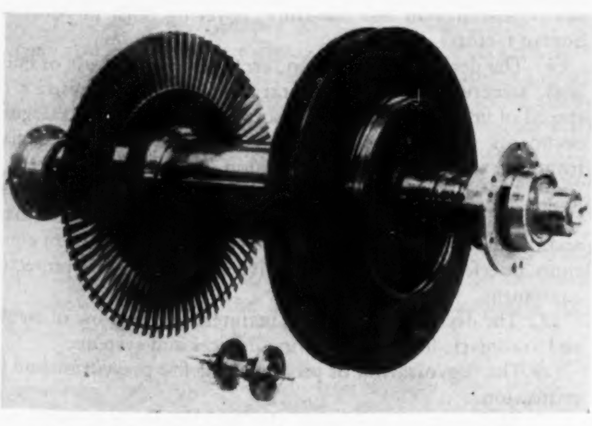


FIG. 13 SUPERCHARGER ROTOR OF STANDARD DESIGN FOR SMALL AND VERY LARGE ENGINES

FIG. 14 SMALL SUPERCHARGER ROTOR CARRIED BY LITTLE SWISS GIRL

The FIRE-PROTECTION ENGINEER'S ROLE

By JEROME A. JOHNSON

FACTORY INSURANCE ASSOCIATION, HARTFORD, CONN. MEMBER A.S.M.E.

THE wave of destructive fires, particularly hotel fires, in the United States has brought the problem of fire control and fire protection abruptly to the public attention. While everyone knows the tragic results of the Winecoff Hotel and La Salle Hotel fires, probably less known is the fact that the nation-wide fire loss for 1946 was $561,487,000, the highest loss in 20 years and the second highest in United States history.

An unusual number of big fires involving $250,000 damage or more, occurred in 1946 as well as an increased number of other fires in virtually all parts of the country. With hundreds of millions of dollars worth of irreplaceable raw materials, lumber, food, valuable inventories, as well as badly needed homes, apartments, and other buildings going up in smoke, the situation has become so critical that President Truman has called a National Conference on Fire Prevention, to be held in Washington this spring.

After the disastrous hotel fires, citizens everywhere took stock of the hazards in their own communities, and found to their amazement that the same shocking conditions, such as open stairways and elevator shafts, flimsy doors, open transoms, lack of fire partitions and sprinkler protection, (which caused the heavy loss of life in the Winecoff and La Salle fires) were prevalent in tall buildings in virtually every city in the nation. The hazard of inferior construction, with its attendant non-standard electrical installations, afflicts hundreds of schools, hospitals, churches, and public buildings throughout the land. Vermont has already held a meeting, led by State Fire Marshall Kirby, which stressed the needs of community inspection and new stringent laws, and has submitted concrete recommendations for consideration of the governor and legislature tending to reduce the possibilities of holocausts in that state.

When the experts meet in Washington this spring to draft plans for better fire prevention and fire protection throughout the nation, they will draw heavily on the accumulated experience of fire-protection engineers, who have been safeguarding industrial property for more than 50 years. The reduction of fire losses in industry has been so definite, particularly during the recent war, that the nation, faced with a desperate fire emergency, can learn much from the work of these men.

CONTRIBUTIONS OF THE FIRE-PROTECTION ENGINEERS

It will doubtless be true that some measures of adequate inspection, proper construction, safeguarding of special hazards, and constant supervision which the fire-protection engineers have been literally "forcing" on industry will be recommended to the country as a whole.

When the amount of industrial and commercial property exposed to loss is considered, the achievements of the nation's fire-protection engineers in lowering fire losses are apparent. Through their efforts, the average cost of insurance has dropped from 84 cents per $100 in 1835 to 3 cents in 1935 and the loss ratio has dropped from 63 cents to 2 cents in the same period, according to one insurance organization.

The fire-protection engineer contends that his position in modern industry is analogous to that of a doctor or lawyer to a client. He is engaged as a consultant and may be dismissed at will. But unlike a doctor or lawyer, the fire-protection engineer, through his employers, usually the fire-insurance companies, is prepared to back up his judgment and experience with cold cash. He even pays for his mistakes or omissions, for when fire breaks out as a result of the fire-protection engineer's lack of foresight, the insurance company frequently has to pay the loss under policy terms. In some cases the companies pay even when management fails to follow the fire-protection engineer's recommendations or is slow in putting them into effect and fire breaks out before corrective measures are taken.

FIRES ARE PREVENTABLE

The fire-protection engineer tackles his job of guarding a modern plant under the assumption that all fires, except those resulting from acts of God and war, are preventable and can be predetermined. Rarely does a fire occur in a fire-protection engineer-inspected plant that has not been foreseen by the engineer. However, forewarned is not always forearmed when managements fail to heed the recommendations, or when changes in occupancy of plants or hazards occur without anybody bothering to notify the fire-protection engineer.

Part of the history of fire-protection engineering has been a struggle for recognition of the highly professional character of the work. During the war, this type of engineering was officially defined for the first time by the War Manpower Commission and the National Roster of Scientific Personnel.

FUNCTIONS OF THE FIRE-PROTECTION ENGINEER

This definition states, "the fire-protection engineer is concerned with safeguarding life and property against loss from fire, explosion, and related hazards." He deals with the following, as taken from the definition of functions:

(*a*) The reduction and control of fire hazards due to processes subject to fire or explosion in respect to design, selection, methods of installation and handling, covering both physical and human factors.

(*b*) The design, construction, arrangement, and use of buildings, structures, and transportation facilities, to restrict the spread of fire, to facilitate the escape of, or otherwise safeguard occupants in case of fire, and to minimize potential damage from fire, water, smoke, or explosion.

(*c*) The design, installation, and maintenance of automatic and other means conducive to the detection of fire, and alarm and other signaling systems for notification of fire or of conditions interfering with the effective function of fire-protection equipment.

(*d*) The design, installation, maintenance, and use of manual and automatic fire-extinguishing devices and systems.

(*e*) The organization of personnel for fire prevention and fire protection.

(*f*) Measures to minimize the incidental or consequential loss or damage to subsequent fires.

As the definition states, the fire-protection engineer works

to prevent destructive fire, explosion, lightning, or other damage to property, often including wind and water damage, from causes other than fire.

He is concerned with preserving manufacturing plants and facilities, storages of materials, and other property from such damage. He is further concerned with long-term cost reduction through properly planned fire-protection programs, the avoidance of interruption to production, the loss of essential services, death and injury to persons, and all economic losses resulting from property destruction, including loss of jobs.

PROFESSIONAL REQUIREMENTS

While neither the National Fire Protection Association nor the National Board of Fire Underwriters, the principal national fire-prevention organizations, has professional requirements for classifying fire-protection engineers, the National Roster of Scientific Personnel has stated that a state license as a professional engineer constitutes an indication of professional status but that lack of a license is not an indication of nonprofessional status. To meet the National Roster's requirements, a fire-protection engineer must have at least a bachelor's degree in a recognized branch of engineering and not less than two years' experience in which fire protection was his sole or major responsibility.

In the field, the fire-protection engineer must show a thorough familiarity with such technical data as the quantities and pressures of water needed for fire protection, the arrangement of pipes, valves, hydrants, reservoirs, tanks, and pumps. He must also know the occupancies of structures and their particular fire problems; such as the storage or processing of a wide variety of materials with special hazards.

He must know the features on which the successful operation of automatic sprinklers, fire alarms, and other devices depend. He must be able to review plans for installation of heating, ventilating, lighting, and power equipment to avoid sources of fire danger.

He must be able to deal with the storage, handling, manufacture, and processing of flammable solids, liquids, and gases which require special treatment involving due recognition of physical and chemical properties, flash points, ignition temperatures, explosive ranges, and limits. He must know the appropriate fire resistance necessary for various types of structures and fire test ratings of various assemblies.

In other words, he has to be virtually a chemist, a physicist, an electrical, hydraulic, structural, chemical, and mechanical engineer, and sometimes even a marine engineer, with something more than a nodding acquaintance with each field.

To qualify for his job of foreseeing and preventing fires, the fire-protection engineer attends no school of clairvoyancy, although many of his clients think that he has because many a fire has occurred where he said it would. In addition to these qualities, the competent fire-protection engineer is also something of a psychologist, and definitely a public-relations man and salesman.

It frequently takes more than engineering ability and background to convince management already harassed by shortages, labor troubles, or absenteeism that they need to spend additional money for added fire protection. Only a salesman with a good understanding of the psychology of the businessman will be able to convince the latter that a new sprinkler system will save him money in the long run.

FIRE-PREVENTION ENGINEERS' WORK COVERS MANY FIELDS

Fire-protection engineers are to be found in a variety of businesses, including research into and development of all manner of firefighting and fire-protective equipment, the maintenance, inspection, and testing of that equipment, as instructors at colleges, technical schools, and in employee-training programs, in the management and administration of fire-protection programs for industry, in charge of technical sales and service of fire-protection equipment, and in editorial and publicity fields promoting fire prevention. However, most of them are at work safeguarding business, commercial, and industrial properties as part of the service rendered by the nation's fire-insurance interests.

The skilled fire-protection engineer also acts as something more than an engineer in matters relating to insurance. For example, he is frequently useful in pointing out to plant managers and owners the need for keeping their insurance coverage adequate during these inflationary times. Some managements are slow to realize that if their factories are still insured at 1940 levels, they could collect only a portion of the total loss if they were to have a fire. Many plants would cost 70 per cent more to replace today than they did in 1940. Thus it can be seen that the fire-protection engineer sometimes acts not only as a conservator of a factory's dollars but of its physical resources as well.

Three insurance organizations, the National Board of Fire Underwriters, with its affiliate, Underwriters' Laboratories, Inc.; the Factory Insurance Association, a group of capital stock fire-insurance companies; and the Associated Factory Mutuals, a group of mutual fire-insurance companies, employ among them some 500 engineers. Probably five times as many are employed by the inspection boards and bureaus maintained by the insurance business throughout the forty-eight states.

WORK DURING WAR PERIODS

This pool of fire-protection skill and experience was one of the nation's first lines of defense during both world wars. In the first world war, fire-insurance engineers and other employees of insurance organizations throughout the nation inspected tens of thousands of plants in a conservation program under the Fire-Prevention Section of the War Industries Board. Again, in the recent war, volunteers from all types of fire and property insurance organizations inspected thousands of factories, grain elevators, warehouses, and other facilities where vital and critical materials were stored. They served under general direction of the National Bureau of Industrial Protection which was organized by the Insurance Committee for the Protection of American Industrial Plants. All these services, involving thousands of man-hours, were provided free of charge to the Government.

Engineers from the National Board of Fire Underwriters organized and manned advisory fire-protection bureaus for the War and Navy Departments and the Coast Guard. Other engineers worked with the Office of Civilian Defense in preparing the nation's air-raid-precaution program. Fire-insurance engineers assisted the Army and Navy Air Forces in perfecting techniques of incendiary bombing, for example.

The wartime service of fire-protection engineers proved without doubt their potential value when industry is able to take full advantage of their abilities and their advice is heeded. The fire loss in war industry in the last war was held to a point 40 per cent lower than in the first world war. In Army property alone, the fire record per $1000 of property exposed was characterized as only "approximately 50 per cent of that expected to be the normal loss of civilian property."

At this point, the question may logically be asked: If the fire-protection engineers are so good, why have United States fire losses steadily increased for the past 3 years and jumped 25 per cent since the end of the war?

In fairness to the fire-protection engineer, it must be pointed out that while industry generally is under their care much of

the increased losses has occurred outside their jurisdiction. The fire loss in dwellings, which represents about one fourth of the national loss, is not the direct responsibility of the industrial fire-protection engineer, for instance. Neither are farms and rural property, which account for another quarter of the loss. Public buildings, commercial buildings, forest lands (of which 31,000,000 acres, an area the size of New York State, burn over annually) do not come within the scope of the industrial fire-protection engineer. From these consideration it will be seen that only a relatively small portion of the annual United States fire loss is incurred on industrial property, even though such values represent a large share of the nation's wealth.

INDUSTRIAL FIRES ON THE INCREASE

However, it is a fact that fires on industrial property have increased. The National Fire Protection Association reported recently that large-loss fires, involving $50,000 or more, increased 48 per cent in the first quarter of 1946. Regarding this increase, and the general increase in fire losses, there are many theories.

A. C. Hutson, Assistant Chief Engineer of the National Board of Fire Underwriters, in a speech before the International Fire Chiefs' Association stated that increased values are in part a factor. He also blamed the tendency to build factories, supermarkets, and other high-value structures in suburban areas where water pressures are weak and alarm service nonexistent. He blamed lack of enclosed stair and elevator shafts, automatic sprinklers, and adequate alarm service in most of America's older buildings.

There is no doubt that the increased fire losses are an aftermath of war, the result of overcrowding, building shortages, and a general relaxation of the safety rules and precautions that prevailed during the war. Prentiss D. Reed, dean of independent insurance adjusters, speaking before the Risk Research Institute in New York, blamed the increased losses on deferred repairs, improper fusing, poor housekeeping, congestion, and untrained and inexperienced personnel. Among the latter are the janitors and watchmen, many of whom are never trained to know what to do in case of fire. Too often, say fire-protection engineers, the watchman's job is considered a sinecure for an old employee who ought to be pensioned.

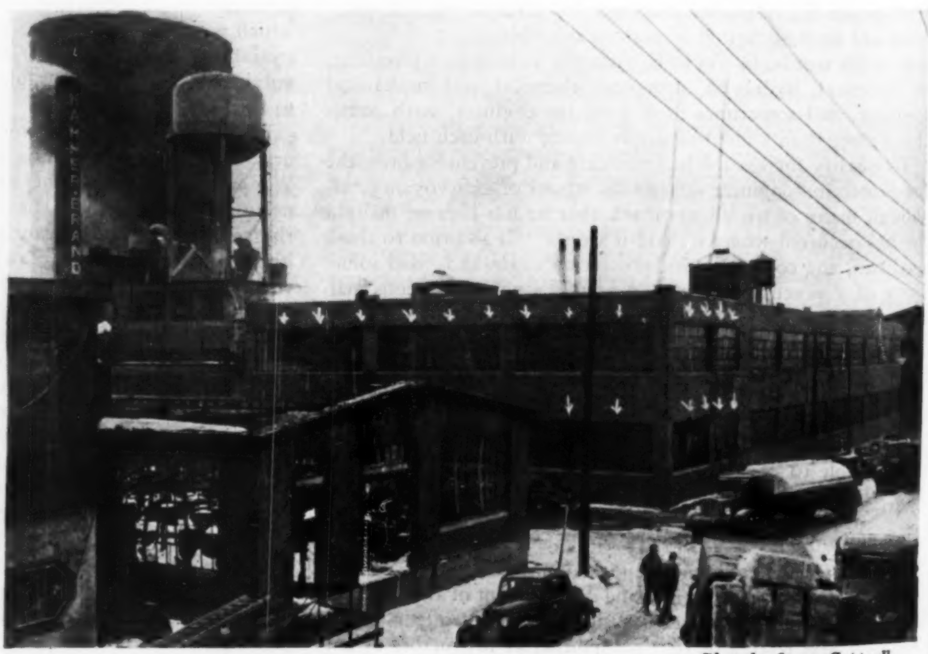
PRECAUTIONARY MEASURES PREVENT FIRES

The simple fact that carelessness causes fires and that precautions prevent them is strikingly shown by reports of the engineers which reveal that almost all of the "large-loss" fires occur in so-called "safe" plants, where extra precautions sometimes are thought to be unnecessary. The fire record of facilities handling extremely dangerous materials, such as oil refineries and powder plants, is surprisingly good. Where safety measures are relaxed, fire is sure to strike. The primary duty of the fire-protection engineer is to ascertain the need for safety measures, make the recommendations, and try to see that they are enforced.

Disastrous fires still occur in modern industry in spite of all that engineering skill can do to prevent them or to limit their spread. In practically every case, the fires were beyond control of scientific minds. For instance, in Langley, S. C., last summer, fire broke out in a cotton mill which was protected by automatic sprinklers and automatically closing fire doors. That fire should have been put out by sprinklers a few minutes after it started. Instead, the fire destroyed the whole factory, causing one of the greatest fire losses in years, $3,800,000, because a sprinkler valve controlling the area where the fire started had been left closed after repairs were made to the system.

FIRE-PROTECTION-ENGINEERS DIVISION OF SOCIETY PROPOSED

Many fire-protection engineers already are members of the A.S.M.E., and the suggestion has been made that they form a Division of the Society. Such an organization would serve several useful purposes, in providing another means of interchanging ideas and information concerning the science of fire protection, discussing mutual problems, and assisting in raising the professional standards of fire-protection engineering. If this organization could be accomplished, the combined intelligence and experience of the members would be a potent force in the ever-continuing fight against the fire danger that threatens American industrial and economic life.



THE FIRE-PROTECTION ENGINEER CALLED THE SHOT

(Two years ago an A.S.M.E. fire-protection engineer retained by the Herman Basch and Company of North Bergen, N. J., through their insurance carrier, recognized the heavy exposure hazard of a lacquer factory across the street. He predicted the lacquer works would blow up, and he recommended a water curtain (open sprinklers at each exposed window) be installed. The lacquer works blew up on February 12 with a general-alarm fire resulting, but the water curtain prevented any loss to the Herman Basch plant. This photo shows the ruins of the lacquer factory in the left foreground, and the undamaged Herman Basch plant in the background. Arrows indicate the open sprinklers. If the Basch plant had burned, the damage could have run into eight figures.)

Photo by Carew-Caldwell

Factors Rarely Considered in SMOKE ABATEMENT

By HENRY F. HEBLEY

DIRECTOR OF RESEARCH, PITTSBURGH COAL COMPANY, PITTSBURGH, PA. MEMBER A.S.M.E.

JUST prior to the recent war, there was ever-increasing growth in the social conscience of many communities which manifested itself in the demand for slum clearance, reduction of congested areas, and smoke abatement. Then the war required an "all-out" effort, and the agitation for a reduction in the atmospheric pollution in centers of population was in abeyance during the emergency.

With the cessation of hostilities, there has been a return to the consideration of the amenities of urban communities. This is evidenced by the great activity present in dozens of cities large and small in the demand for smoke abatement.

SMOKE-ABATEMENT SOLUTIONS FOLLOW FAMILIAR PATTERN

For the most part, those pressing for a cleaner atmosphere are intensely sincere in their efforts and are firmly convinced that their particular solution of the problem is the only correct one and the only one which should be adopted. This solution generally follows a familiar pattern:

1 Stress the need for smoke-abatement legislation as a health measure.

2 Adopt the Ringelmann chart as the standard for measuring the density of the smoke emitted from a chimney over a stated period of time, in order to determine a violation.

3 Adopt a specification involving the weight of fly ash per cubic foot of flue gas and qualifying the particle size and the CO_2 content of the flue gas.

4 Adopt a so-called "volatile clause" that limits hand-fired boilers and heating equipment, both commercial and domestic, to the use of solid fuel that does not contain more than 23 per cent volatile matter on the dry basis. Such solid fuel is nominally classed in the coal trade as "smokeless."

5 Adopt a clause that makes it unlawful to import, sell, offer for sale, exchange, deliver, or transport for use and consumption within the city limits, or to use or consume within the city limits any solid fuel for hand-fired equipment that does not meet the definition of "smokeless solid fuel."

6 Adopt a clause requiring all truckers delivering solid fuel within the city limits to apply for a license and post a bond to insure the delivery of "smokeless solid fuel" to consumers using hand-fired equipment.

7 Provide a penalty that would forfeit the bond and cancel the license of any trucker who violates the provisions of No. 6, regarding the delivery of "smokeless solid fuel."

Many other clauses are adopted pertaining to inspections; approval of new installations, permits, fees, etc., but for the purpose of this text, they will not be considered. The seven points enumerated form the salient factors.

The strategy adopted in pressing for enactment of smoke-abatement laws is to urge it as a health measure. It is felt that the law will then have a better chance of withstanding attacks on its constitutionality.

Contributed by the Fuels Division and presented at the Annual Meeting, New York, N. Y., December 2–6, 1946, of The American Society of Mechanical Engineers.

In all public hearings regarding this problem, the evidence also follows a similar pattern:

1 Medical testimony is offered indicating the prevalence of diseases of a respiratory nature in urban populations where smoke in the atmosphere is considered excessive. The common cold, pneumonia, and sinus infections are noted, and the strength of the correlation between dust fall and deaths from pneumonia, tuberculosis, etc., is expressed by presenting correlative coefficients. Less emphatic statements are presented to the effect that lack of sunshine (ultraviolet rays) contributes to a general lowering of the populace's health, and is in part responsible for the depressed feeling experienced on murky days—even to the extent of suicides.

2 The influence of the smoke problem on the cost of living is presented in testimony on the cost of cleaning, painting and decorating, laundering, the maintenance of buildings, etc.

3 The impairment to flora in urban centers, brought about by smoke-laden atmosphere.

The whole matter becomes highly controversial and the original aim, namely, to reduce the amount of atmospheric pollution in urban areas, becomes lost. Such a result is unfortunate as no matter which group is successful, it is of little help if the solution advocated fails. In order that a better appreciation of some of the underlying influences may be gained, these notes have been prepared.

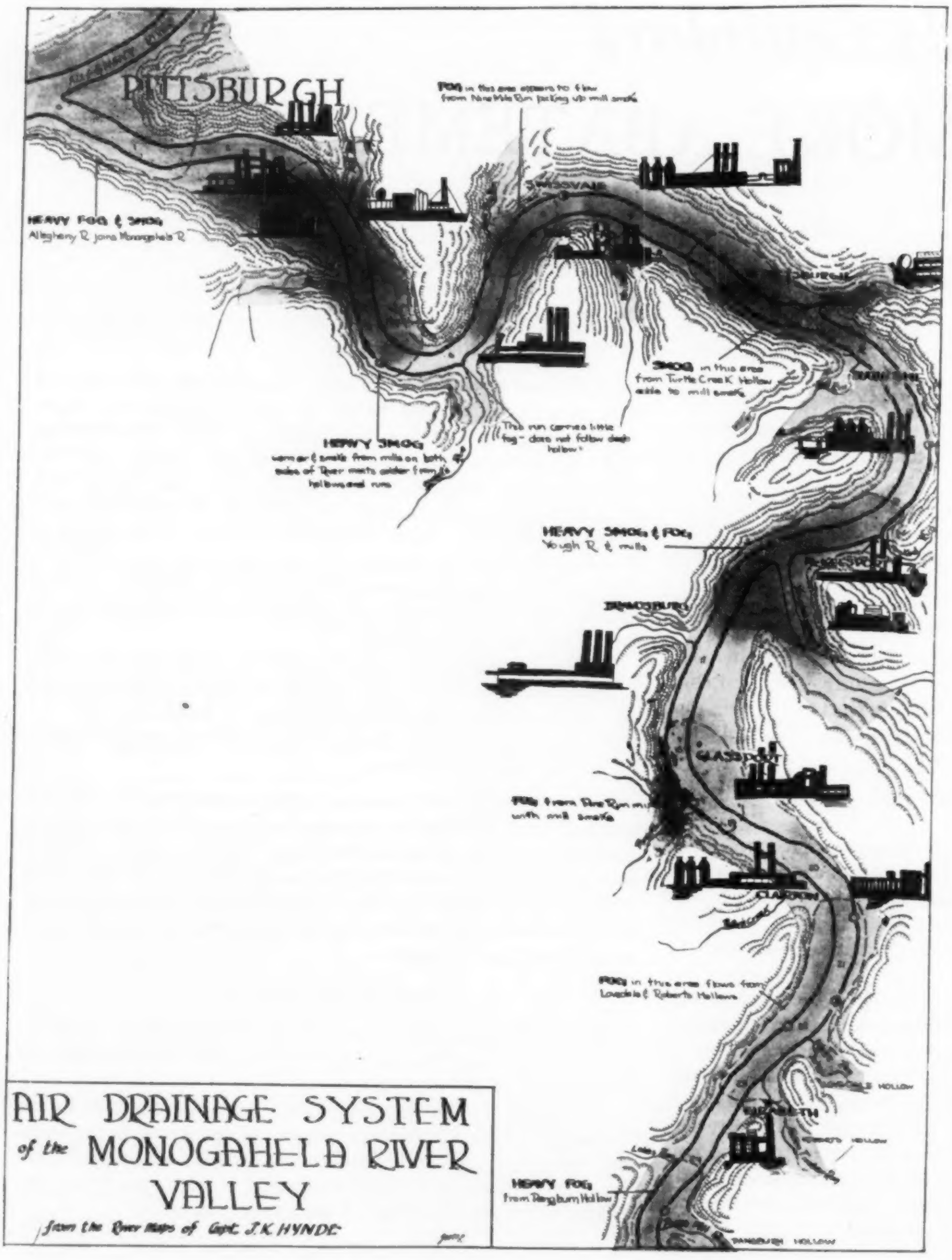
DUST OR SOOT DEPOSITS

One of the usual methods of attack on the problem of smoke is to set up sampling stations for the collection of deposits settling out of the atmosphere.

The weight of the depositions are generally computed on a monthly basis and from these results the deposition is projected to tons per square mile. Sometimes samples of the collected material are analyzed. Such analytical work varies from comparatively routine to a rather elaborate procedure.

Insoluble matter	Tar Carbonaceous other than tar Ash
Soluble matter	Loss on ignition Ash
Included in soluble matter	Sulphates (SO_3) Chlorine (Cl) Ammonia (NH_3)

These results of the monthly deposits in tons per square mile are often used in correlation with respiratory diseases to indicate the strength of the influence of deposits on health. Unfortunately, little or no planning of the investigation is adopted and the variables existing make the reliability of the results open to question. For instance, in the heart of a city with "skyscrapers" standing next to four- or five-story structures or to parking lots, the elevation of the deposit gage is a factor. Placing the receptacle at street level may be influenced by purely



AIR DRAINAGE SYSTEM of the MONOGAHELA RIVER VALLEY

from the River Maps of Capt. J.K. HYNDE

with so many factors obscured that the problem of analyzing and interpreting the data collected becomes extremely difficult.

Many of the data dealing with dust and soot fall that have been presented at public hearings have been invested with an accuracy and reliability which, when analyzed, is quite misleading. To associate them statistically with the number of deaths from pneumonia or tuberculosis and report the relation to the extent of correlation coefficients is unwarranted. The use of correlation coefficients should be practiced with judgment. One can get an excellent correlation between the growth of the office boy and the growth of the company's business.

There is also a tendency to draw conclusions based upon samples that are entirely inadequate and cover periods of time that are far too short. The Department of Scientific and Industrial Research, in its investigation of atmospheric pollution, uses the average of monthly observations of at least 5 consecutive years for a basis of comparison in which confidence can be placed. The monthly deposits recorded for any single year when compared to the 5-year average may show great deviation, probably brought about by the variables previously mentioned. A glance at these will indicate that weather influences predominate.

local conditions and the observations may be vitiated by vandalism. The shelter that may be afforded a gage by the proximity of a building has been known to make the observations worthless.

If the deposit gage is located in a park or open space, the influence of the filtering effect of trees, shrubs, etc., is related to the position of the gage in relation to the borders of the park.

As pointed out in the scientific survey of the atmospheric pollution in the City of Leicester by the Department of Scientific and Industrial Research (1)[1] some of the differences encountered between the determinations of a certain deposit gage in two consecutive months are brought about by the following: Wind direction; atmospheric turbulence, both dynamic and thermal; humidity; rainfall; seasonal variations; irregular variations; other miscellaneous factors. Thus it leaves the investigator

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

It is desirable therefore that the modern climatologist, skilled in the new techniques developed during the last 5 years, become closely associated with the planning and execution of any investigation involving the variable influence of the weather, and its effect on air pollution. In so far as can be ascertained, the skill of these technologists has not been called upon.

In further consideration of the analysis of the deposit observations, there are two other factors that will bear some thought:

1 The area of influence, contributing to the matter deposited in the collection gages.

2 The area assigned to a deposit gage, whose weight of collected material will be projected in tons per square mile of that area.

Item 1 requires the consideration of the source of the material deposited in the gage. So far these points of origin have not

been definitely placed and there is even great uncertainty regarding the location.

Studies have indicated that when the material deposited is divided into insoluble and soluble matter, there seems to be some relationship between the amount of rainfall and the amount of soluble matter deposited (1).

Such a relationship suggests the possibility of clouds carrying considerable soluble matter, and also of the raindrops washing some of the impurities out of the atmosphere as they fall.

The direction of the wind and its velocity may contribute to the deposit gages material from distant areas. Brotzman has stated that given a wind velocity of 10 mph, air pollution originating at Youngstown, Ohio, at say midnight, can be over the Pittsburgh area the next morning, while that city's pollution will be carried to some other section. The well-known experience will be recalled that during the periods of the dust storms in the western prairie states, air-borne dust was deposited along the eastern seaboard. As a matter of fact, the climatologist depends upon the analysis of this air-borne dust to type it for origin.

Item 2 is an important matter. The deposit gage has a collecting funnel 12 in. in diam or 0.78 sq ft. It is on this area that the tons per square mile are predicated. If the determination of one gage is projected to this area, the ratio is 1:35, 000,000. Such a small sample requires that the greatest skill be exercised in the selection of the gage location, striving to place it in an area that is quite uniform and free from a concentrated local pollution.

It is quite possible that greater accuracy could be attained through the use of a number of smaller receptacles placed uniformly over the area, averaging the deposits collected and analyzing a composite sample. Every effort must be made to avoid too elaborate procedure calling for a great volume of analytical work. Such a method generally involves great expense and effort, and the work is abandoned before a long enough period has elapsed to yield to confidence in the results.

ATMOSPHERIC POLLUTION IN SUSPENSION

In addition to the material collected in the deposit gages, there is the great amount of pollution that is held in suspension in the atmosphere. It is composed of a number of materials. Particles of carbon, plant spores, dust, fumes, mist, fog, and the gases of combustion including smoke.

The Ringelmann Chart. In the United States, practically the only measure that is adopted for measuring such suspended impurities is the Ringelmann chart. It can be applied only to flagrant cases of air pollution as it depends upon a visual estimate of the color of the products of combustion being emitted from the chimney under observation. It is a convenient measure for the personnel of the smoke-abatement department of any city to use; but the data yielded by the observations are inadequate if the aim of any municipality is to gain a measure of its atmospheric pollution in order to reduce it.

Marks (2) has already drawn attention to its weak points, although for some reason not known, this criticism has not received its proper consideration. In so far as can be ascertained, the selection of smoke inspectors does not require any close examination of their eyesight. The task of inspecting a chimney is essentially one of matching the shade of the smoke emitted with a set of standard charts.

The late Dr. J. S. Owens (3), in calibrating his scale of shades for the automatic filter, recognized the limit of sensitivity of the eyes and made a study of the error involved. He states: "As the error in reading shades is a fraction of the brightness, and this depends on the proportion of white in the shade, its reflection factor, and illumination—the effect of the two latter (must be) considered."

TABLE 1 RINGELMANN CHART

Chart no.	White, per cent	Black, per cent
0	100	0
1	80	20
2	60	40
3	40	60
4	20	80
5	0	100

Individuals familiar with the use of the chart are aware that the percentage of the white area varies inversely with the chart number, as indicated. With this qualitative measure one even encounters inspectors who discuss the shade reading to the nearest tenth. Such factors as wind velocity, diameter of stack, position of observer, background, and illumination have a noticeable influence on the shade reading.

The chart has another great limitation. It can be employed only during the hours of daylight.

If atmospheric pollution in suspension is going to be analyzed in a rational manner, a quantitative measure of that pollution should be adopted. The impurities may be expressed in milligrams per cubic meter, under standard conditions, or some other convenient basis.

In addition, the sample should be drawn throughout the 24 hours of the day. Recently, Prof. Sumner B. Ely, Superintendent of Smoke Prevention of the City of Pittsburgh, conducted some tests approaching this method. He used an instrument previously developed for some research at the Mellon Institute in Pittsburgh. The investigation was conducted to ascertain any significant changes in the atmospheric pollution of Pittsburgh during the period of the steel strike. It will be recalled that the strike lasted from January 28 to February 17, 1946, a period of 3 weeks.

In brief, the instrument uniformly draws a measured quantity of air per day of 24 hours through a special filter paper which travels at a uniform rate, possibly 1 in. per hr.

The "shade" of black is the measure of the suspended impurities per unit volume of air. Once again a "qualitative" measure is involved. The translation of these qualitative shades into a "quantitative" measure expressed in "milligrams per cubic meter" has been carried out. It will be described later.

The difficulties of conducting such an investigation were well nigh insurmountable.

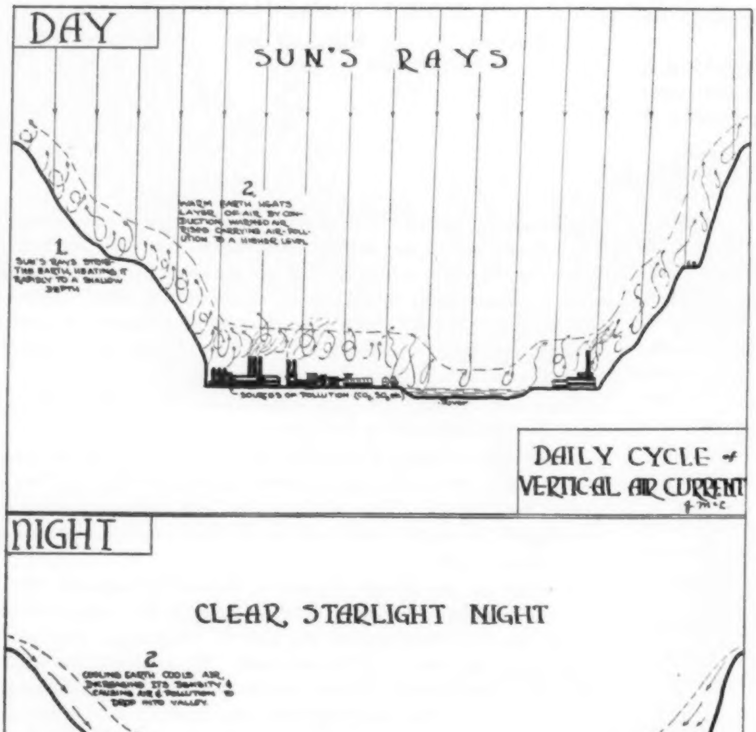
Only one instrument was in operation. It was located at the City-County Building. It leaves the "representativeness" of the sample open to serious question. Possibly this could have been overcome with additional instruments; but neither were they available nor was there sufficient competent personnel on the staff of the Smoke Prevention Bureau to service the instruments and collect, present, and interpret the data.

With only a few instruments available, it may have been practical to design the experiment on a statistical basis using modern techniques similar to those adopted by the U. S. Forestry Department for determining the precipitation reaching ground that is heavily forested (4).

Apart from the sampling problem, the period of time investigated, namely 21 days, is entirely inadequate.

It has been found, based on a recent survey of the City of Leicester (1), all of the sampling points measuring suspended matter have shown on one day, 5 or 6 times as much impurities as on the following day. A possible explanation for this great variation is the degree of turbulence experienced in the atmosphere from day to day. Because of these factors, the conclusions regarding the reduction of air pollution due to the steel strike did not show any strong significance in the statistical sense.

Another comparison for the same period was made, based on the visibility observations of the Pittsburgh Station of the



Little work has been done in the United States following this method of investigation. The procedure, however, introduces a new aspect to the problem.

That is the concept of air volume in atmospheric pollution. Impurities in suspension are related to the cubic measure of the atmosphere.

Until comparatively recently, most weather forecasting was carried on from the ground and little investigation was made of conditions aloft. The growth of air travel, especially during the war, made the study of atmospheric conditions, including the third dimension, imperative. A similar approach is essential in the investigation of atmospheric pollution. In recognizing this influence as associated with the volume of air enveloping and spread above a center of population, there are a number of factors to be given consideration.

Wind velocity is important. According to H. Landsberg (6), cities of large dimensions tend to reduce wind velocities compared to the rural areas that surround them. The ability of wind to carry air pollution for many miles is well known, and it is that action which has encouraged man to discharge his products of combustion to the atmosphere, hoping that wind movement will scavenge the impurities and send them elsewhere.

Apart from wind transport, there is the very important influence of turbulence. Eddy currents varying from, say, a few feet to miles in diameter and experiencing vertical movements as well as those of translation, are dominant factors in changing the concentration of impurities in the atmosphere. The turbulence may be dynamic in nature caused by the energy contained in the air masses. In addition there is the vastly important thermal turbulence that is experienced. This influence on the impurities in the atmosphere cannot be overestimated. The atmosphere of a city is never completely at rest throughout any 24-hr day; and the variation in the turbulence will bring about rapid changes in the quantity of air pollution, as the eddies cause an exchange of polluted air from below with the clean above. How frequently has it been observed that on one day the air is polluted and on a following one it is clean. Yet there has been no great change in the fuel used in the area. The action of turbulence in relation to urban air pollution is not properly understood at present and a great deal more investigation is required.

U. S. Weather Bureau. The visibility readings for the period of January 28 to February 17 were studied for each of 16 consecutive years.

There was a slightly improved visibility record for the 1946 period; but when the other influencing factors are considered, the improvement was not strongly "significant."

In 1918 the late Dr. J. S. Owens developed an automatic filter designed to draw regular samples of air from the atmosphere at the rate of approximately 2 liters per hr. The air is passed through filter paper leaving a stain 1 in. in diameter. Calibration of the stain with unit weight per unit volume was carried out with great care and precision, giving a measure that could be reported in milligrams per 100 cu m. For a description of the method of calibration of the automatic filter, refer to the work of J. G. Clarke (5).

A further development of the measure of suspended impurities in the atmosphere is the smoke filter in which an air pump draws a sample of air throughout the day and passes it through a filter and, subsequently, to an absorbtion bottle for volumetric SO_2 determination and a dry gas meter for air-volume determination.

A calibrated photocell equated to direct weighings of samples of impurities filtered from the atmosphere is used in conjunction with a galvanometer to measure the light passing through the stained filter. The results are reported in milligrams per cubic meter.

INVERSION

The association of strong winds with low barometric pressure is well known. It is also a fact that the frequency of passage of such lows is greater in winter than in summer, so that the average wind velocity is higher in winter than in summer. Yet the air pollution is generally greater in winter. This is due to the effect of another factor, namely, the stability of the air. Air is stable when the colder air underlies the warmer air. This is inversion.

If the third-dimensional study of the atmosphere in relation to air pollution is continued, the influence of the phenomenon of inversion of the temperature gradient of the atmosphere will be found to be of importance. Under normal conditions, the temperature of the atmosphere is lowered with increasing altitude at the approximate rate of 1 deg F for each 300 ft of eleva-

tion. When this relationship is in effect, warm air adjacent to the ground will obey the tendency to rise to be replaced by cold air, thus setting up convection currents and turbulence. There are times, however, and they occur more frequently than realized, when the normal temperature gradient becomes inverted. In other words, there is a stratum of air at a certain elevation which has a distinctly higher temperature than the layers of air below it. This is the condition of stability previously noted. Such a stratum effectively acts as a ceiling or lid to imprison the impurities released by any center of population.

Under such stable anticyclonic air conditions with but very slight turbulence, inversions have been known to last for days, sometimes with disastrous results. Probably the best known example of recent years was the tragic event experienced in the Meuse Valley in December, 1930. Stable air at high barometric pressure and practically no turbulence was present for a number of days. The city of Liege (Belgium), dominated by heavy industry, is situated on the river Meuse. The narrow valley of the river adjacent to the city became filled with the gases of combustion released from the factories of Liege because of a temperature inversion encountered at the low level of 270 ft above the bottom of the valley. The condition persisted for 4 days, during which time there were hundreds of cases of respiratory attacks with 63 deaths occurring on December 4 and 5. Numerous cattle had to be slaughtered. The inversion conditions disappeared December 6 and the respiratory attacks abated.

Subsequent investigation indicated that the primary cause was the presence of sulphuric acid formed from SO_2 released in the products of combustion (7).

Inversions may be conveniently classed as low and high. The example cited would be classed as low, and the gases of combustion released from chimneys are kept down close to the ground causing murky conditions at building levels and in the street. Another example of the same class given by Owens occurred at the Kew Observatory, 10:40 a.m., December 11, 1934.

Table 2 illustrates the inversion conditions:

TABLE 2 INVERSION CONDITIONS AT KEW OBSERVATORY

Elevation Ground level—datum	Temperature, deg F
100 ft above datum	32
200 ft above datum	31
300 ft above datum	31
400 ft above datum	31
500 ft above datum	31
600 ft above datum	31
650 ft above datum	45

If the stratum of warm air is at a high level, then the impurities associated with the gases of combustion are lifted well above the tops of the buildings, but will accumulate as a heavy black layer that effectively prevents daylight from penetrating and causing darkness in the city, forcing the use of light in homes and offices and headlights on automobiles and streetcars. Such an inversion was experienced in Pittsburgh at 4:00 p.m., November 11, 1946 (Table 3).

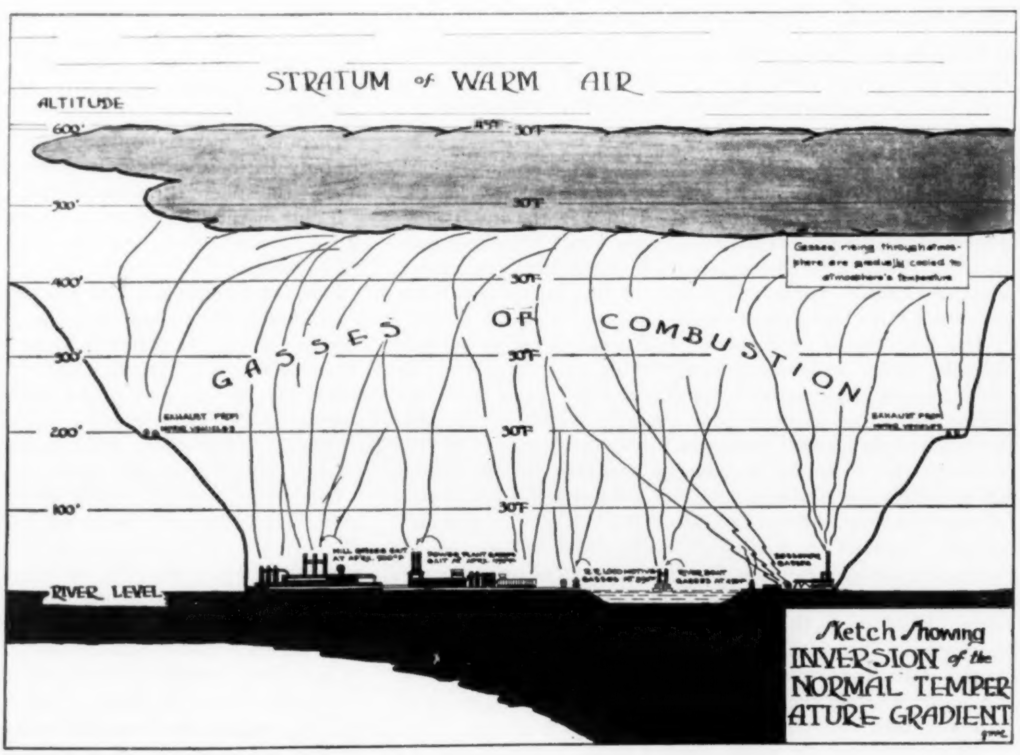
TABLE 3 OBSERVATIONS OBTAINED FROM U. S. WEATHER BUREAU, PITTSBURGH, 4:00 P.M., NOVEMBER 11, 1946

Elevation, ft (Ground level, 1250 ft above sea level)	Temperature of Atmosphere Deg C	Temperature of Atmosphere Deg F
1250	6	42.8
2000	4	39.2
3000	2	35.6
4000	—1	30.2
5000	—3	26.6
6000[a]	—2	28.4
7000[a]	—1	30.2
8000	—2	28.4
9000	—3	26.6
10000	—2	28.4
11000	—3	26.6
12000	—5	23.0

[a] Warm layer.

If inversion conditions continued for a sustained period of time, the amount of solid impurities being emitted by the chimneys of a city would ultimately reach a state of equilibrium with the amount of deposition equaling the solids discharged. However, the atmosphere would become intolerable, not because of the visible particles (smoke) but because of the greater amounts of gases of combustion that carry those particles, namely, the sulphur dioxide (SO_2) and carbon dioxide (CO_2).

These gaseous products of combustion, invisible though they are, form the basis of the air pollution associated with indus-



trial centers. They cannot be overrated, as on the average there are at least 50 times more of these gaseous particles of combustion in the atmosphere than there are solid (smoke and dust) particles.

FLY ASH

With the development of the art of burning pulverized fuel in suspension, the problem of particles of ash being discharged from the stack into the atmosphere has become increasingly serious. Due to the method of firing, combustion is practically complete, with the result that the fly-ash particles are composed of inert matter; silica, alumina, etc. The particles vary in size from those that fall to the ground quite rapidly, to those that are borne for miles on the wind and air currents that pass by the chimney.

Efficient mechanical and electrostatic dust-collection equipment is available to meet the requirements of any of the existing clauses limiting fly-ash emission. The clauses, however, generally adopt the A.S.M.E. Tentative Method of Testing Dust Collection Apparatus as part of the ordinance, by reference, with little or no knowledge of the requirements contained in those test methods, and no knowledge of the practical difficulties involved, of the problem of obtaining a representative sample, nor the cost of such a test. One proposed ordinance recently prepared contained a clause applying the A.S.M.E. Methods of Test to locomotives in operation. Fortunately, wiser and more experienced counsel prevailed and the section was deleted. The particles of ash and carbon that are emitted and held in suspension in the air represent approximately 2 per cent of the total amount of material held in polluted air. According to modern climatological research, dust and smoke particles are classified as inactive. In other words, they ordinarily do not intereact with the water vapor in the air and take little or no part in the condensation processes in the atmosphere that lead to haze and fog.

CONDENSATION NUCLEI

Two kinds of suspensions pollute the atmosphere, as follows:

1 Dust, and that includes sand, carbon particles, ashes, rubber from tires, clay, brick, etc.

2 Condensation nuclei, which, due to their chemical nature, attract water vapor from the air to form minute visible or invisible droplets.

These condensation nuclei play an important role in the formation of fog, haze, clouds, and rain. In the free atmosphere, the nuclei present the surfaces on which the vapor condenses. These nuclei themselves are invisible to the naked eye and can be made visible only in the electron microscope when magnified many thousands of times.

The long list of condensation nuclei is headed by sulphur dioxide, which, under the influence of sunlight, turns into sulphur trioxide, and with its associated water vapor from the atmosphere forms sulphuric acid. Sulphuric acid is responsible for much of the corrosive effects on city structures; it is also the cause of the irritating and biting sensation in the throat. Other substances acting as nuclei are nitrous and nitric oxides, phosphorus, and common salt. The chief "man-made" sources of nuclei are industrial furnaces and processes of all kinds, such as blast furnaces, Bessemer converters, open hearths, rolling mills, coke ovens, and all industrial and domestic chimneys. In addition, there are the transportation facilities, such as steam and Diesel locomotives, steam and motorboats, trucks, automobiles, and airplanes. In short, all combustion processes, no matter whether the fuel be solid, liquid or gaseous, will contribute nuclei.

These condensation nuclei abound in the atmosphere; and even in the purest country air, sufficient nuclei are always present to produce fogs, if the general large-scale weather conditions are conducive to it. There is always an excess of nuclei present in the air, so that even in the densest fog there are a great many nuclei which have not taken part in the condensation process.

In regard to the Diesel engine, it has been found that the cleanest Diesel exhaust contains many condensation nuclei.

The air-pollution problem in cities and industrial areas is not solely concerned with the visible nuisance caused by smoke and dust. The overwhelming excess of nuclei and their relationship to the ever-changing weather conditions represents a much more complex and important aspect of the problem.

Industrial areas and large cities are copious producers of particles that present surfaces for the condensation of atmospheric moisture. In addition, such areas are usually located in the vicinity of water surfaces for convenient transportation. In that regard, the spray from the sea contributes quantities of particles of salt that act as condensation nuclei.

While fog formation is facilitated by the presence of abundant nuclei and of water vapor, other large-scale factors such as wind, temperature distribution with elevation, etc., must fulfill certain conditions before actual fog will form. If these conditions are fulfilled, then fog will form at an earlier hour and last a longer period of time in industrial areas than at localities where pollution is relatively small. The reason for this ease of fog formation and its persistence is of interest.

In air of low relative humidity, the hygroscopic condensation nuclei, originally extremely small solid, liquid, or gaseous particles, attract water vapor in which they dissolve to form an invisible droplet of a salt or acid solution. With an increase in relative humidity up to approximately 70 to 80 per cent, the droplets at first grow slowly. At relative humidities above 80 per cent, the rate of droplet growth is more rapid and the droplets finally become visible.

In pure country air, fog will not become visible until a 100 per cent humidity has persisted for some time, as the relatively few droplets must grow to a considerable size before they have an appreciable effect on the transparency of the air. On the other hand, in industrial areas haze and fog become apparent at relative humidities far below the saturation point, as a large number of small droplets greatly reduce the transparency of the air.

There is no material difference between nuclei, haze, and fog, the only distinction being the degree to which the transparency of the atmosphere is reduced by the suspended droplets.

If dust or particles of carbon are mixed with the fog, the so-called "smog" results and the visible conditions of pollution are aggravated.

In an industrial area, the condensation nuclei composed of sulphur dioxide are among the most serious. The Meuse valley tragedy (7) was caused mostly by the sulphuric acid formed from these combustion products. So far, however, none of the ordinances that have been adopted have shown any realization of the complex problem confronting communities in abating the air pollution. Clearly, the Ringelmann chart is inadequate as a measure of the factors that have been described.

In addition, it would be advantageous to know the pH value of the rain and possibly fogs and clouds over an industrial city. The CO_2 present in an industrial atmosphere is generally accepted as bringing the pH value of rain to 5.5. However, some rain has shown a considerably lower value.

The use of low-volatile coal, while undoubtedly easier to burn without releasing quantities of smoke that would violate an ordinance, would still not overcome the fog-producing condensation nuclei. A glance at Johnstown, Pa., and Charleston, W. Va., where the domestic fuels are low-volatile coal and natural gas, respectively, will indicate that given the right

weather conditions the air pollution present will aid in forming fog.

APPROACH TO SOLVING THE POLLUTION PROBLEM

In so far as the clauses on licensing, bonding, and transporting fuel in the areas covered by the ordinances, these are purely ways and means of policing the area to insure the enforcement of the "low-volatile" clause. Other methods, no doubt, could be devised that would be equally effective from a policing point of view. From what has been said, it will be apparent that this subject of atmospheric pollution has not received the consideration that its difficulty and importance demand. There has been a tendency to assume that legislation and agitation will solve the matter. These activities are necessary; but, unless smoke abatement is based upon a painstaking and unemotional research, these two measures in themselves will never overcome the difficulty. Some of the factors involved have been given in this text. Other questions that are pertinent to the subject still lack an answer. Here are a few of them:

1 What shall be considered as atmospheric pollution?
2 What quantity of pollution is present in a city's atmosphere?
3 Where was that pollution produced, locally or by outside sources?
4 When was that pollution produced?
5 What percentage came from Industry? Commerce? Domestic?
6 What distance does pollution travel?
7 What is the variation of pollution with time; that is, by years, by seasons, by days, and by hours?
8 What quantitative measures can be adopted?
9 What practical measure can be adopted to reduce air pollution, both by prevention and removal?

Such questions require a carefully planned program of investigation and research considered from a "long-range" point of view. The subject is so complicated and has so many facets that the co-operative skills and experience of many professions are needed.

"Combustion engineers" are needed for their knowledge in the use of fuels.

Climatologists are needed for their experience in the influence of the weather; topography and terrain on the atmospheric-pollution problem.

Doctors are needed to advise on the extent of the influence of atmospheric pollution on health.

Economists skilled in engineering economics are needed to warn against fantastic solutions of the problem.

Statisticians skilled in the collection, analysis, presentation, and interpretation of data are needed to plan the investigation, set up the sampling procedure, and report the results in a modern statistical manner.

Chemists are needed because of their skill and experience in the reactions that take place in this problem.

It is imperative that these varied skills be brought into close co-operation in the study of the matter. The exchange of knowledge regarding the subject is greatly needed. A close alliance should be made with colleges conducting research in climatology, the U. S. Weather Bureau, and certain co-operating bodies interested in the problem of atmospheric pollution.

Much of the sampling, taking of observations, and recording of the data in convenient form for statistical analysis could possibly be arranged in co-operation with the science departments of the senior high schools.

Adequate mathematical equipment for the statistical work should be available, and the reports should be prepared as far as possible for the general reader.

What is actually needed is a modern research program in atmospheric pollution.

ACKNOWLEDGMENT

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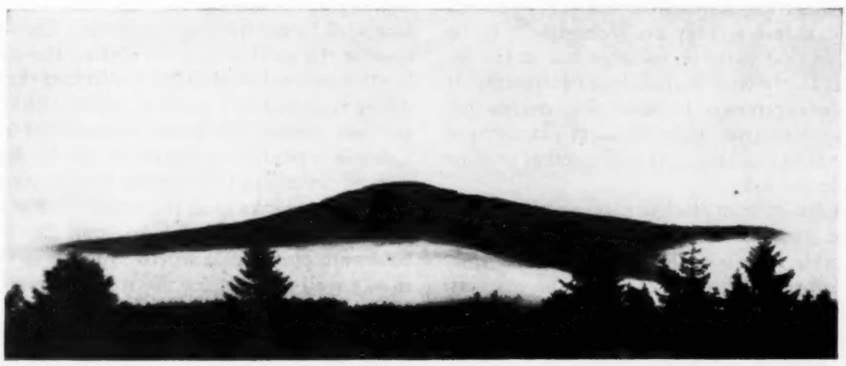

RESULTS OF A TEMPERATURE INVERSION

(Picture taken from mountainside and looking across toward another mountain peak shows this peak standing above sea of fog that fills lower levels. Top surface of fog is quite sharply separated from layers of warm air that rest above fog. An excellent example of what happens in Pittsburgh. The cold air in valleys is unable to rise through warm layers at hilltop and fog and some impurities are effectively imprisoned until weather conditions—wind and turbulence mostly—destroy the phenomenon. Photograph courtesy of Dr. H. E. Landsberg, Director of Joint Research and Development Board, Washington, D. C.)

WAGES *and* PRODUCTIVITY

By R. S. TUCKER

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IN approaching the problem of the relation between wages and productivity, the fundamental fact is that wages can only be paid out of production. Their total is limited by the volume of goods and services in existence, and usually by the volume of goods and services being currently produced, although occasionally for a limited period they can be paid in part out of the accumulated store of goods previously produced. So much is axiomatic. The big question is whether wages should not only be limited but measured by the volume of production.

Are wage earners, or hired employees in the broader sense, entitled to the whole output of society? Or are the wage earners in any given plant, corporation, or industry entitled to the whole output of that plant, corporation, or industry? Obviously, to anyone but a Marxian socialist the answer is no, since the wage earners, obviously, are not responsible for the whole output. Production results from the combined efforts of labor, management, and capital, with an occasional assist from the Government.

A variation of the foregoing proposition, not often formulated in words but implicit in much discussion, is that all increases in output should go to the laborers, i.e., the management and the investors shall receive only a fixed amount and the hired employees take the rest. This also appears to be unethical as well as unwise. The laborers are not morally entitled to the increase unless they are responsible for it through harder, more intelligent, or more skilled work. That, however, is very rarely the case.

WHAT IS THE MEASURE OF LABOR PRODUCTIVITY?

The situation has been obscured by the common use of the terms "output per man-hour" and "productivity of labor," as if they were synonymous. Increases in the output per man-hour very rarely represent increased effort or improved skill on the part of workers. They are almost always the result of improvements introduced by management, making use of capital supplied by investors, and of materials and methods devised by scientists, and adapting the product to the needs and means of consumers. If any laborers are responsible for the increased output of any plant or industry, they are more likely to be laborers not employed in that plant or industry but in the industry supplying that industry with materials or equipment. It would scarcely be an exaggeration to state that output per man-hour is usually a better measure of the actual productivity of almost anybody or anything else than it is of the actual productivity of the laborers on the job.

Output per man-hour differs from place to place and from shop to shop. Can anyone maintain that the differences between profitable and unprofitable industries in this respect stem from the differences in the effort, skill, or strength of the workers? Output per man-hour also has differed from time to time and has shown a marked tendency to increase over the years. This has not been an automatic process. It would be unsafe to project into the future the same rate of increase that has prevailed in the past, even if agreement could be reached as to what that increase has been. It would be unsafe to project that rate without considering what have been the causes of increased productivity in the past and whether those causes are to be permitted to continue in the future.

The vast increases in output per man-hour in the past decade do not reflect any changes in the laborers. Anthropologists will not admit any improvement in the character or intelligence of workers in this country. Some old-fashioned Anglo-Saxons and narrow-minded Nordics would claim that the change has been in the opposite direction. Workers certainly work no harder. On the contrary, not only have hours been decreased but the effort required in each hour has been reduced. There is more power and more comfortable seats, more convenient work benches, better ventilation, better lighting, better sanitary facilities—even music is being provided. Probably there are fewer illiterate or non-English-speaking workers than there were thirty years ago; but on the other hand, there are fewer who have had years of training as apprentices in specialized skills. Consequently, the figure obtained by dividing total output by the number of man-hours is no measure of the real contribution of labor, and its use as such serves only to mislead.

The chief cause for the increase in output per man-hour has been the vigorous enterprising spirit of managers and promoters, and the willingness of investors to take chances. It is only through the medium of managers, promoters, and investors that scientific discoveries can be exploited for the benefit of the consumers. The profit motive has been the device by which philosophical and academic speculations have been compelled to serve the wants of the common man. If we wish productivity to continue to increase, we must carefully avoid taking steps that will discourage the profit motive.

MARGINAL PRODUCTIVITY

Although the output per man-hour-considered as an average has no bearing on the proper remuneration of labor, economists of what is known as the neoclassical school have come to agree that what is called "marginal productivity" is the proper and, in the long run, the effective determinant of wages. The value of an hour of labor is the amount by which the output of any plant or operation would be increased by adding one hour or decreased by subtracting one hour. Obviously, this is not the same as the total output divided by the total number of hours. In all industrial or physical operations there is a law of diminishing returns and a point at which the further applications of any one production factor increase the output less and less. Labor is a productive factor subject to the law of diminishing returns. Perhaps this is most vividly stated in the old proverb "Too many cooks spoil the broth." But even before the cooks become numerous enough to spoil the broth, the additional cooks are plainly not worth as much as the original staff, and in any well-run kitchen the wage rate will be adjusted accordingly.

This calculation of marginal productivity is a matter of estimates on the part of each employer, sometimes assisted by cost accountants. Hundreds of thousands of employers, their plant managers, superintendents, and foremen, each making his own estimate of the value that might be added by hiring another man, determine how many shall be employed at any given wage. The laborers also make their own estimates as to whether they

(*Continued on page 292*)

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What Is a PENSION PLAN?

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IT MAY be said that any method which is used to retire employees on any sort of a stipend can be called a pension plan, no matter how informal or unsystematic the arrangement may be; how lacking in security and guarantees; how inequitable as between one employee and another; or how inadequate to fulfill the functions of a real plan.

The type of pension plan which will be discussed, however, is an orderly arrangement for the sound financing and guaranteed payment of specific benefits to superannuated employees.

It is formal, secure, equitable, and adequate. It is called a "group annuity plan."

It is formal because its provisions are specific and contractual.

It is secure because the benefits which are purchased are guaranteed by an insurance company.

It is equitable because the amount of pension and other benefits which each employee receives are determined by a nondiscriminatory formula.

It is adequate because it provides sufficient pension to permit the orderly retirement of employees at normal retirement age.

WHY SHOULD AN EMPLOYER BUY A PENSION PLAN?

Among other reasons which might occur to the reader, the following are fairly obvious:

It provides for an orderly retirement of superannuated employees on a scheduled preplanned basis, thus opening the way to promotion among the younger employees and promoting efficiency.

It relieves the employee of the fear of dependent old age.
It promotes public good will.
It improves the employer-employee relationship.
It has certain tax advantages.

The author subscribes to these reasons but, in his opinion, they simply add up to the fact that an employer should adopt a sound insured pension plan for one basic, fundamental, and all-important reason, namely, it is good business.

As a matter of fact, an employer cannot, in any event, avoid the cost of pensions.

In every well-established organization which does not have a sound pension plan, there will be found long-service employees who have passed their period of practical efficiency and whose earnings are considerably higher than those of young, short-service, more efficient employees doing similar jobs.

This phenomenon is the natural consequence of human depreciation coupled with the impracticability of reducing the wages of faithful long-service employees in proportion to the reduction in their productivity.

Now the difference in the unit operating cost to the employer in the case of these two types of employee surely represents a pension cost which should be clearly recognized and properly financed.

A hit-or-miss plan under which employees are retired in some haphazard manner and paid out of current earnings does not recognize the fact that employees depreciate just as surely as machinery depreciates; it does not recognize the fact that the accruing pension liability each year that an employee works should be discharged in that year; and it does not recognize the fact that to postpone the adoption of a sound pension plan simply throws upon some future management the pension problem which for each year of postponement becomes more difficult to solve.

Thorough and accurate accounting methods demand a recognition of accrued and accruing pension liability.

It is suggested that the adoption of a sound group annuity plan, properly designed to meet the needs of the individual employer, offers a practical, economical, and equitable solution to the problem.

WHAT ARE THE ESSENTIALS OF A PROPERLY DESIGNED PLAN?

In the author's opinion, apart from the employer's contributions, there are six essential elements to every properly designed pension plan; they are:

1 Eligibility requirements.
2 Normal retirement age.
3 Amount of pension.
4 Amount of employee contributions.
5 Death benefits.
6 Withdrawal benefits.

While these elements are subject to considerable variation as demanded by circumstances in a particular case, and while many sound plans appear to be much more complicated than would be indicated by a mere recitation of these six essentials, it is believed, nevertheless, that a plan which is constructed with the proper consideration and determination of each of these six elements will be a sound plan. Therefore it is advisable to discuss in some detail each of the six essential elements.

1 *Eligibility Requirements*. Ideally, perhaps, the plan should cover all employees who may be termed "permanent" employees. However, this term is only relative and in one sense of course there are no permanent employees. Therefore it is necessary to study the personnel data and available records carefully in order to determine what eligibility requirements would include the relatively permanent employees and therefore be appropriate in each individual plan.

Eligibility requirements may be based upon one or more of the following: (*a*) service, (*b*) age, (*c*) salary, (*d*) job classifications.

(*a*) *Service*. In organizations under which the turnover among employees is high during the early years of employment, it is advisable to establish a fairly long probationary period which must be served by an employee before he becomes eligible. Therefore it is not uncommon to have a waiting period of as much as 5 years in certain types of industries. However, in organizations with relatively low turnover, the probationary period is usually much shorter. In fact, in some plans, all employees in service when the plan is adopted are permitted to join regardless of length of service, although for new employees some probationary period is usually desirable.

It is, perhaps, advisable to establish some probationary period for all new employees, even where turnover is relatively low.

(*b*) *Age*. It is sometimes suggested that the employer's cost should be reduced by eliminating employees below a certain age such as age 30 on the theory that even with fairly long

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service the turnover among employees under age 30 is relatively high and an employee covered under a plan from age 30 to age 65 will receive a fairly adequate pension. It is further argued on behalf of such a provision that a pension plan does not appeal to young employees and that therefore if the plan is contributory on the part of the employees, it is difficult to get a satisfactory participation among the young ones.

However, since it is impossible to determine in advance which employees will remain in service until normal retirement age, and since even with fairly liberal pension credits, the resulting pensions will not be redundant even if the employee has 40 or 45 years of coverage, it is often thought inadvisable to restrict the benefits by having a minimum age requirement. Experience has shown that a high percentage participation can be obtained even among very young employees, and actually the employer's net cost for this group is very small.

(*c*) *Salary*. In some organizations the pension plan is limited to salaried employees to the exclusion of wage earners or hourly paid employees. Quite often this is so because the turnover among the wage earners is so high as to make a pension plan of little practical value to them because of short periods of coverage. Furthermore, in some organizations it might be very difficult to get a satisfactory participation on a contributory plan among the employees who are on an hourly paid basis.

In addition to limiting the plan to only the salaried employees, the requirements might limit eligibility to employees earning over a certain amount such as $1500 per year or $3000 per year.

Generally speaking, it is, perhaps, inadvisable to set a minimum salary requirement even though the Social Security Act is heavily weighed in favor of the lower salaries, although such a requirement might be indicated in specific cases.

(*d*) *Job Classifications*. In some cases it is advisable to eliminate entirely employees in certain job classifications because of high turnover, great fluctuation in number of days of regular employment per year, seasonal work, or other considerations.

It is extremely important to keep in mind in deciding upon the eligibility requirements for an employer that the final provision must be such as can satisfy the requirements of Section 165 (*a*) of the Internal Revenue Code in order that the plan may receive approval from the Commissioner of Internal Revenue.

2 *Normal Retirement Age*. Age 65 is almost universally considered appropriate as the normal retirement age, especially for men, except that occasionally for the older ones in service when the plan is adopted, a graded retirement age is sometimes suggested.. For practical reasons it might be advisable, for example, to grade the retirement ages so that no employee retires until the plan has been in effect at least 5 years. Under such a plan, employees age 60 and under when the plan is adopted would retire at age 65; employees age 61 when the plan is adopted would retire at age 66; employees age 62 would retire at 67 and so on. It is seldom practical to consider a normal retirement age higher than age 70.

Age 60 is sometimes chosen as the normal retirement age for women.

Age 60 is also appropriate for male employees in the air personnel of airlines, for bus drivers, and for some other occupations which cannot be satisfactorily carried on by the average employee over age 60.

All plans have provisions under which individual employees may be retired before or after the normal retirement age.

If an employee retires before the normal retirement age, his pension is reduced because of the earlier age at which it starts and the longer period over which it will be paid.

On the other hand, the pension is not generally increased by service after the normal retirement date. Deferment of pension during continuance of employment is recognized by a cost-credit to the employer.

The employer establishes a dangerous precedent when he keeps employees in service after normal retirement age because this defeats the very purpose of the plan.

3 *Amount of Pension*. It is generally considered proper that the final total pension be a function of and directly related to service and earnings. There are various ways to do this, but one simple, practical, and fairly common way is to establish what we might call a straight 1 per cent plan for both future service and past service; future service being service rendered on and after the effective date of the plan, and past service being service rendered before that date.

Let us illustrate how the plan works. Consider an employee who earns $2400 during the first year that the plan is in effect: There will be purchased for him a pension credit of $24 per year to commence at the normal retirement date. This would be payable at the rate of $2 per month. If his earnings remain the same during the second year that the plan is in effect, he will have purchased for him an additional $24 per year to commence at normal retirement age and so on. If therefore the employee is covered under the plan for 30 years at the same annual rate of earnings, his future-service pension will be 30 × $24 or $720 per year, which would be payable at the rate of $60 per month.

It is quite a common practice to give a higher pension credit on that part of earnings in excess of $3000 than is given on the first $3000, so as to compensate to some extent for the fact that under the Social Security Act the excess of earnings over $3000 per year is disregarded. Instead of a straight 1 per cent plan, for example, the pension credit might be 1 per cent on the first $3000 of earnings in each year, and 2 per cent on the excess. If an employee earns $3600 in one year, his yearly pension credit, based upon this salary that year would be $42; that is, 1 per cent of $3000 plus 2 per cent of $600. This would be payable at the rate of $3.50 per month commencing at normal retirement age.

In calculating the past-service pension, the basic rate of earnings in effect when the plan is adopted is usually used. Thus if an employee's basic rate of earnings is $2400 per year, and if he is entitled to 10 years of credited past service, his yearly past-service pension will be 1 per cent of $2400 or $24 for each such credited year, making a total of $240 of yearly pension which would be payable at the rate of $20 per month commencing at normal retirement date.

His total pension will be the sum of his future-service pension and his past-service pension.

Occasionally, and perhaps more equitably, the salary taken for the purpose of calculating past-service pensions is the average salary over a period of years, such as 10 years, immediately preceding the adoption of the plan.

Of course other salary bases are occasionally used, such as total past earnings.

Although, in the author's opinion, the most equitable past-service rule recognizes all past service (after excluding the number of years corresponding to the waiting period which must be served before new employees become eligible), the fact is recognized that expediency occasionally demands a modification of this rule. For example, it might be necessary from the cost standpoint to eliminate all service rendered prior to a certain age such as age 35 or age 40.

Again, for the sake of economy, it might be necessary to limit the total number of years of credited service to, say, 20 years.

There are almost innumerable ways to reduce past-service liability by reducing the past-service credit but it is not thought to be necessary to pursue the matter too far at this time. The fact should be emphasized that each such expedient departure

from a recognition of full past service is probably a move in the direction of inequity.

Where necessity dictates the need for restricted past-service pensions, however, a practical plan based on the facts of the case can be worked out.

It is important to see to it that the final rule adopted does not result in "discrimination" as that term is used in Section 165(*a*) of the Internal Revenue Code.

4 *Contributions.* For a few years, recently, there has been a noticeable increase in the percentage of pension plans written on the noncontributory basis, that is, with the employer paying the entire cost. Perhaps one reason for this is that under the then existing tax laws an employer in the excess-profits-tax brackets felt that the difference in cost between a contributory plan and a noncontributory plan was negligible. It is believed that trend will now be reversed.

It is felt that in the long run the contributory plan, under which the future-service pensions are bought jointly by the employees and the employer, is to be preferred both from the point of view of the employer and of the employee.

The employee cannot lose his contributions made under an insured group annuity plan because they are returned either in the form of a cash withdrawal benefit, a death benefit, or in annuity payments.

Indeed, to many young employees the savings feature of a contributory plan may for a while seem more important than the old-age income feature.

Then too, a contributory plan is much less paternalistic, and employees generally are opposed to paternalism. They prefer to enter a plan under which they join with the employer in providing for their old age. Employees under a contributory plan thus feel that they have earned the pension as a right and that it is not something given through paternalism. Therefore, better employee-employer relationship is engendered.

Furthermore, experience over a long period of time has shown that in employee benefit plans, employees have a greater appreciation of the benefits they help to pay for, and they often place little value upon benefits which are free.

Finally, with the same employer outlay, larger pensions can be provided under a contributory plan than under a noncontributory plan, thus providing more satisfactory incomes for the employees who remain to receive annuities.

The contribution rates from the employee should be set sufficiently low so as to be within their ability to pay, in order that a satisfactory employee participation be obtained. A very practical employee contribution for a straight 1 per cent pension plan would be 2 per cent of the employee's earnings, so that the employee earning $2400 per year would contribute $48 during that year for a yearly pension credit of $24. In other words, the employee would contribute during the year an amount equal to twice the yearly pension credit. In some cases it might be practical to have the yearly contribution equal to $2^1/_2$ times or even 3 times the yearly pension credit, but a rather low rate of contribution is preferable.

5 *Death Benefits.* On the standard, noncontributory, group annuity plan there are no death benefits because the employer's money is used more effectively on the no-death-benefits basis to provide straight life annuities for employees who stay with him until normal retirement age. The basic purpose of a pension plan is to provide pensions, and it seems inappropriate therefore to purchase death benefits which in effect reduce the amount of pension otherwise payable for the same employer premiums.

When an employee contributes toward the cost of a plan, however, the situation is entirely different because it would not be practical to ask employees to contribute if on death their contributions were forfeited. The contributory plan therefore provides for a return of the employee's contributions on death before retirement and the plan recommended by the author allows interest in these contributions. The rate of interest is 2 per cent nowadays.

On death after retirement, the death benefit is the return of the employee's contributions plus interest to retirement date, less pension payments received.

6 *Withdrawal Benefits.* Under the standard, noncontributory, group annuity plan, there are no cash benefits available to the employee on termination of service. The only separation benefit to the employee under such a plan is the paid-up annuity which has been purchased for him and this is available only if the employee has fulfilled the vesting requirements which will be discussed later.

Under a contributory plan, the employee on termination of employment is entitled to elect to receive a return of his contributions with interest.

Alternatively, the employee may leave his contributions with the insurance company and receive a paid-up annuity to commence at normal retirement date in the amount which his own contributions have purchased. Most plans, however, go further than this and provide that on fulfilling certain so-called "vesting requirements," the employee who leaves his own money in the plan will receive credit for a part or all of the pension which has been purchased for him by the employer. This is what is termed a vested right in the annuity purchased for the employee by the employer's money.

There are a great many variations in the vesting clauses which have been adopted. One type of requirement is a combination of age and years of coverage under the plan. Under such a clause, for example, an employee would qualify for vested rights if on termination of service he had had 5 years of participation in the plan, and had attained age 40.

Another type of requirement combines age and service as, for example, attainment of age 45 and completion of 15 years of service.

Still another type depends only upon service and allows vesting after, say, 20 years of service.

And there are other types.

Some employers feel that it is advisable to adopt a graded vesting provision under which, for example, one third of the employer-purchased annuities would vest after 10 years of service; two thirds after 15 years of service; and all after 20 years of service.

The author is not greatly concerned with the specific provision adopted but is firmly convinced that every pension plan should have some form of vesting in order to protect the employees. Otherwise, an employee has no assurance whatsoever that he will have any pension purchased for him by the employer. For one reason or another his services might be terminated just before reaching pension age and in that case, without a vesting provision, an employee has under a contributory plan only that which he purchased for himself and under a noncontributory plan, nothing.

When an employee leaves the service, not in ill-health, and does not qualify for a vested right in the pension bought for him by the employer, there is a cost credit given to the employer based upon the premiums paid with respect to that employee's coverage.

WHAT DOES A PLAN COST?

It is impossible to answer this question with any degree of accuracy without making a calculation based upon a list of the employees to be covered showing for each one the date of birth, the date of employment, sex, and salary.

There is such a great variation as between one group and another because of varying lengths of service, age distribution, salary ranges, and percentage of women (for whom annuity

premium rates are higher than for men) that there is no such thing as an average cost per dollar of pension credit or per employee.

An exceedingly rough approximation to the future-service employer cost of a 1 per cent plan with the employees contributing 2 per cent would be from 4 per cent to 6 per cent of the pay roll of the employees covered under the plan. In any particular case the cost might be outside of these limits.

With respect to past service, it is even more hopeless to attempt to make any practical estimates, because in addition to the age, sex, and salary from which the future-service cost can be calculated, the length of service has such an important bearing on the past service cost, and service, as is well known, can vary in length from 1 year to 45, or even 50 years.

The cost of the future-service pensions is paid each year as the pension credits accrue.

The cost of the past-service pensions may be paid outright at the inception of the contract by a single premium payment, but more commonly the cost is spread over a period of years. At the present time, many employers are paying for their past-service pensions by yearly payments of 10 per cent of the original single premium. This is so because the maximum permitted as a business-expense deduction in any one year in the employer's income tax returns is 10 per cent of the original single premium.

This brings up the importance of bearing in mind in cost considerations the fact that the premiums paid by the employer under a properly constructed plan are a deductible item in figuring his corporate income tax.

INCOME TAX ASPECTS

In order that the premiums may be deducted under Section 23 of the Internal Revenue Code in computing the tax, the plan must be approved by the Commissioner of Internal Revenue as meeting the requirements of Section 165 (*a*) of the Revenue Act of 1942, as amended, and the regulations promulgated in connection therewith.

This subject is too long and involved to be discussed at this point. Sufficient is it to say that the objective of the law and regulations is to preclude any plan from obtaining tax exemption which discriminates in the eligibility requirements or in benefits "in favor of employees who are officers, shareholders, persons whose principal duties consist in supervising the work of other employees, or highly compensated employees."

It is the duty of the employer to prepare and file with the commissioner, specified information to enable him to determine whether the plan does satisfy the requirements.

Under a group annuity plan the insurance company supplies the employer with certain of the technical information required for this purpose and he completes the material from his records.

If a plan is approved, presumably, the employer will be permitted to deduct each year the cost of the future benefits, and, in addition, an amount equal to his premium payments for past service but not more than 10 per cent of what the total single premium would be to purchase outright all past-service pensions as of the date the plan was adopted. This 10 per cent figure is subject to adjustments on account of changes in the plan occasioned by withdrawals, deaths, age misstatements, etc.

The present income tax law on pensions was adopted in 1942. It imposed numerous restrictions which did not previously exist, but instead of discouraging the adoption of pension plans, these new restrictions seemed to have had the effect of focusing the attention of the business world on pensions. This, plus the effect of high wartime taxes, salary-stabilization rules, and more enlightened attitude toward employee-employer relationships, has helped to bring about the adoption of greatly increased numbers of soundly financed pension plans.

However, it is believed that even in the absence of excess-profits taxes, salary-stabilization rules, etc., the adoption of properly constructed and soundly financed pension plans will continue at an increasing rate, because the fundamental and basic reason therefor is being more clearly recognized every day—"It is good business."

Wages and Productivity

(*Continued from page 288*)

can, wish to, or must work at the wage offered, and they seek out the employers who are able, willing, or anxious to make the most attractive offers. This process is hindered by labor-union restrictions and by governmental regulations concerning hours and wages. On the other hand, it is helped by employment offices, whether run by unions, government, or private agencies.

If the average output per man-hour is increased for any reason whatever, the chances are that the marginal output will be increased, if not in a particular plant at least in some plants. Under those circumstances some employers become more anxious to get men, and offer higher wages. Growing industries usually pay higher wages in order to attract men away from established industries. Even within a given industry the growing concern usually pays higher wages than the others. In this way laborers obtain part of the increased output in their capacity as laborers. In their capacity as consumers they get even a larger part, because the increasing productivity of industry increases competition and causes prices to be reduced for goods of equal quality. In this way the benefits of increased productivity, although obtained in the first instance by the management and stockholders of the firm initiating the increase, are speedily diffused throughout the community. If, however, laborers exert their power, through organization, to demand for themselves a large part of the increased product, the forces and motivations that lead to increasing product will be killed off and the laborers themselves will suffer along with everyone else. In other words, the "ability-to-pay" theory of wage determination, if adopted, would be an effective device to end industrial progress and to bring about a perpetual depression.

SAME RULES FOR PROSPERITY STILL APPLY

Everyone knows that during the last century the purchasing power of laborers' wages has increased enormously in nearly every part of the western world. This increase took place not because of the activities of labor unions, since it occurred in places where unions were not strong or where they came into existence later; not because of the activities of government, since it was most conspicuous in countries where the government did the least about it; not because of any altruistic or sentimental attitude on the part of employers; not because of the acceptance of any economists' finespun theories, but merely because entrepreneurs are at all times anxious to increase their profits and have found that the most reliable way to do that is to produce more and better goods at a price that more consumers can afford to pay.

To the extent that they have succeeded in increasing their sales they have found it necessary to hire more labor, bidding for it against each other. Consequently, money wages in the United States rose 346 per cent between 1860 and 1932 and, after adjustment for the cost of living, real wages rose 85 per cent. This was at the rate of 2.1 per cent per year for money wages and 0.9 per cent per year for real wages. Even in 1860 real wages were higher here than anywhere else in the world, to such an extent that millions of Europeans migrated here to share in the workers' prosperity. We all, I think, would like to see the increase in real wages continue indefinitely. The only way to insure that it shall do so is to maintain the essential conditions and motivations that have made it possible in the past.

DEVELOPMENTS *in the* PETROLEUM INDUSTRY

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INTRODUCTION

IN the petroleum industry, we have heard much about the remarkable developments in exploration, production, transportation, and many refining processes over the past decade. Many of these were made possible by developments in mechanical fields, such as new materials of construction, new instruments, and new equipment. The mechanical engineer deserves a large measure of credit for the remarkable accomplishments of the petroleum industry, well exemplified in their fulfillment of the extremely heavy requirements imposed by World War II.

EXPLORATION AND PRODUCTION

In the exploration and production field, these mechanical developments have been responsible for our 20,000,000,000 bbl of presently proved crude reserve in the ground in the United States, for the world's deepest producing well (13,778 ft) near New Iberia, La., and for our ability so far to maintain a rate of discovery of crude in the ground greater than current withdrawals. This in itself is quite remarkable, since over 26,000,000,000 bbl of accumulated production has already been taken from the ground in the United States. During the war, in order to conserve 1,500,000 tons of steel, we showed a 34 per cent decrease in the number of new wells drilled for oil and gas but in spite of this, our peak production of 5,000,000 bbl daily was obtained.

Today our new instrument, the radar, will be used for the first time in a ship in searching for oil in the northwest Bahamas. First a diving chamber with radar will plot positions of the rock and sand beneath 2000 sq miles of water, then radar targets 25 ft high will be set up in this area, and a radar screen aboard ship will pick up reflected signals from these targets. Trimetrogon, 3-way air photography for mapping, is new, fast, and very effective for preliminary geological reconnaissance and exploration for large areas. Therefore it is felt that, in spite of the greater difficulty in finding new oil because the "cream has been more or less skimmed off," nevertheless this will be greatly offset by the advances in our technique and equipment for new exploration and the wider fields available, such as intercoastal areas and underwater fields.

Some authorities predict that 30,000,000,000 bbl of additional crude will be discovered in the United States, and that the present world blocked-out crude reserves of 66,000,000,000 bbl will be extended to the impressive total of 490,000,000,000 bbl. This would be equivalent to 100 years of use at a daily rate of about 14,000,000 bbl per day.

Crude-oil reserves in the United States have increased each year from 11,000,000,000 bbl in 1929 to 20,500,000,000 bbl in 1945, with the exception of 1944, due to the war-materials-conservation program, as the annual new discoveries and new developments dropped in 1942 and 1943. The ratio of new discoveries to annual production has held up above 1 since 1934, except for 1943, while the 16-year average has been 1.4, well above the break-even point. The equivalent crude-reserve figures for the Western Hemisphere are 31,000,000,000 bbl and for the Eastern Hemisphere 35,000,000,000 bbl, a world reserve total of 66,000,000,000 bbl. The rate of discovery in the United States up to the war has exceeded the rate of usage of crude so that the reserves have been increasing. There has been a drop in the rate of discovery since 1937 which may be expected to increase again somewhat, although it is becoming more difficult and more costly to bring in new fields. However, the developments in technique of discovery may compensate for this somewhat and there is a good possibility that we may be able to maintain our present proved crude reserve at the 20,000,000,000-bbl level for another decade or more and perhaps even increase it. The real reserve is technology which will be responsible for extending the world crude reserves.

TRANSPORTATION

Petroleum transportation certainly received one of the greatest challenges during the war with the sinking of tankers by submarines. Before the war, the enormous consumption of petroleum products in the North Atlantic area was supplied chiefly by tanker transportation of crude and products from Gulf ports. This tanker route was extremely vulnerable to attack by submarines so that this large volume of oil was soon reduced to a mere trickle. The first needs were met chiefly by railroad transportation when enormous numbers of tank cars were shuttled back and forth between the southwest and northeast and by reversal of some existing pipe lines. The next step was the building by the Government of the 24-in. "Big Inch" for carrying crude and the 20-in. "Little Big Inch" for carrying refined products from Texas to New York and Philadelphia areas in 1942 and 1943. Both of these lines were larger than any previous ones used in the world for transporting petroleum, and they cost approximately $150,000,000.

In 1944, of the 1,700,000 bbl of petroleum and products transported daily from Texas into the North Atlantic area, approximately 40 per cent was transported by pipe line (principally the Big Inch and Little Big Inch) and 40 per cent by railroads, while in 1945 tanker service supplanted much of the railroad haul.

The large network of natural-gas pipe lines throughout the country totals 220,000 miles and a similar network of petroleum pipe lines totals some 170,000 miles. The Big and Little Inch lines, now idle, are being offered for sale and at present sixteen offers for purchase or lease are in the hands of the War Assets Administration and the Surplus Property Administration who say that preference will be given to keeping these lines in petroleum service.

The big tanker-building program of the war has made the United States tanker fleet 3 times the tonnage of that before the war with an annual carrying capacity of almost 4 times as

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much. Whereas prewar tankers had a speed of 10 or 11 knots, the present ones have many rated at $14^1/_2$ knots or better; and prewar ships were approximately 11,000 tons, as compared with new tankers with a capacity of more than 16,000 tons. The T-2 tankers built during the war were of capacity to carry 120,000 bbl of crude with a speed of 14.5 knots, while the T-3 tankers, 150,000 bbl of crude with a speed of 18 knots. Sixty-three of the latter were built. At present the world's largest tanker under construction will be 581 ft in length with an 80-ft beam, and will carry 190,000 bbl of crude, equivalent to eight 100-tank-car trains. Another new tanker has just been completed, the first incorporating radar in the initial installation. All indications are that the world tanker fleet is continuing to build up with a net increase of 138 tankers for the period September, 1945, to June, 1946. These tankers should be of service for carrying South American and Middle East crudes to the United States seaboard as well as for hauling crude and products from the Gulf Coast to the northeastern area. It seems that some 10,000,000 tons of government-owned tanker fleet resulted from the war program, of which possibly 2,500,000 tons will be sold to private companies and 1,000,000 tons will be retained for the Navy.

The large pipe lines of the war point the way toward larger diameter pipe lines in the future, operating at higher pressures and wider station spacings with lower investments and lower operating costs. Automatic control equipment for pressure, temperature, and volume, with remote control, corrosion inhibitors, self-cleaning filters for refined products, and means for moving high-viscosity crudes are all anticipated innovations. Some applications of new techniques have been applied already in the new 18-in. and 20-in. lines from Kettleman Hills to San Francisco Bay, a 175-mile line with 110,000 bbl daily capacity. An advanced and complete telemeter system at the main office near San Francisco automatically gives the volumes of crude passing through the intake and at various selected points along the line. The new pressure-weld process, gamma-ray inspection, somatic coating, and steam-turbine-powered centrifugal pumps at the intake station are some of the innovations. It is of interest to note that the use of airplanes for inspection of long-distance pipe lines is now carried out periodically by many companies.

REFINING

In the petroleum-refining industry, in spite of the unsettled world political picture and domestic industrial uncertainties, the crude run has increased in the United States during 1946 to quantities exceeding those predicted after V-J Day. In the first half of 1946 civilian consumption of gasoline increased 5 per cent over 1941; kerosene 7 per cent; heating oil, Diesel oil, and distillates, 18 per cent; and industrial residual fuel oil 19 per cent over 1941. With further increases of automobile production and stepping-up of industrial activity, it is anticipated that the crude processed in the United States will exceed the present 4,800,000 bbl per day during 1947, and should increase steadily thereafter.

There is also an increase in foreign demands from the United States for petroleum products which are expected to become greater over the next few years until refinery operations in foreign locations are rebuilt or new installations completed. When we realize that the annual consumption of refined petroleum products in this country has averaged approximately 9 bbl per capita while foreign use averages something less than $^1/_2$ bbl per capita, the tremendous potential for increased use of petroleum products in foreign countries is well indicated. It is of interest that, at the close of the war, approximately 73 per cent of all petroleum was refined in the United States, 12 per cent in the Caribbean, 8 per cent in the Near and Middle East, 3 per cent in Canada, and 2 per cent in Mexico and South America. It is expected that during the next decade petroleum-refining facilities abroad will show an expansion, with a tendency to supply the growing markets of Europe, Russia, and Asia with products made in these areas. Some even predict doubling of refining capacity outside the United States in the next 10 years.

Today, American interests own 66 refineries abroad with an approximate total capacity of 875,000 bbl daily. Their interest is 20 per cent in the Middle East, 48 per cent in South America, and 35 per cent in all other foreign countries. Already, large refineries are being projected for the Caribbean, the Persian Gulf, and the Netherlands Indies.

The average annual increase of crude-oil requirements in the United States is estimated as 125,000 bbl per day or about 4 per cent increase each year. It is expected that in the future some of the crude which will be processed in the United States will come from the Caribbean and perhaps even from the Persian Gulf.

GASOLINE

With regard to motor gasoline, the total demand in the United States for all grades of gasoline has increased every year by an amount of approximately 4 per cent annually during each of the 4 years preceding the war. In 1940 the gasoline demand reached a quantity of 1,700,000 bbl daily which was increased to 1,900,000 bbl during 1941, and a peak of approximately 2,000,000 bbl in 1944. During 1944 and early 1945 more than 700,000 bbl per day of this gasoline was produced for military requirements, and the total included 550,000 bbl per day of 100-octane aviation gasoline in 1945. Today the average motor-fuel production is of the order of 2,200,000 bbl daily.

Fig. 1 shows a simplified petroleum-process diagram intended for those not in the petroleum industry to indicate where the refining processes discussed appear in the sequence of converting petroleum crude oil to the various products, i.e., gasolines, distillate fuels, lubricating oils, and chemicals.

Catalytic-cracking capacity in the United States, installed mostly during the war years for the 100-octane aviation program, furnishes a considerable amount of the motor gasoline now used. It is fairly certain that if it were not for the current shortage of lead the premium-grade gasolines would now be close to 85 A.S.T.M. motor octane, regular grade approximately 80, and third grade 70. At present they are more nearly 76–78 and 72–74 for premium and regular because of the acute shortage of lead. During the octane race of the prewar years, premium-grade gasoline reached 80.2 octane number, regular 74.4, third grade 65.6 in 1941. These values were sharply reduced during the war to 76, 72, and 55, respectively, in order to facilitate the production of maximum 100-octane aviation gasoline.

Catalytic-cracking capacity operating and under construction in the States amounts to approximately 1,100,000 bbl per day charge with approximately 110 plants in operation or under construction. Many of the newer plants now being installed are for smaller refineries, with plants ranging in size from 2000 to 6000 bbl per day. The justification for installation of catalytic-cracking units is the improved gasoline yield as well as quality and increase in over-all liquid recovery with reduced production of residual fuel oils.

CATALYTIC CRACKING

Since catalytic cracking has become a major process in the petroleum-refining industry, and many of the problems associated with its developments in practice are mechanical in nature, some discussion of these problems should be of interest to mechanical engineers. In addition to handling vapor and

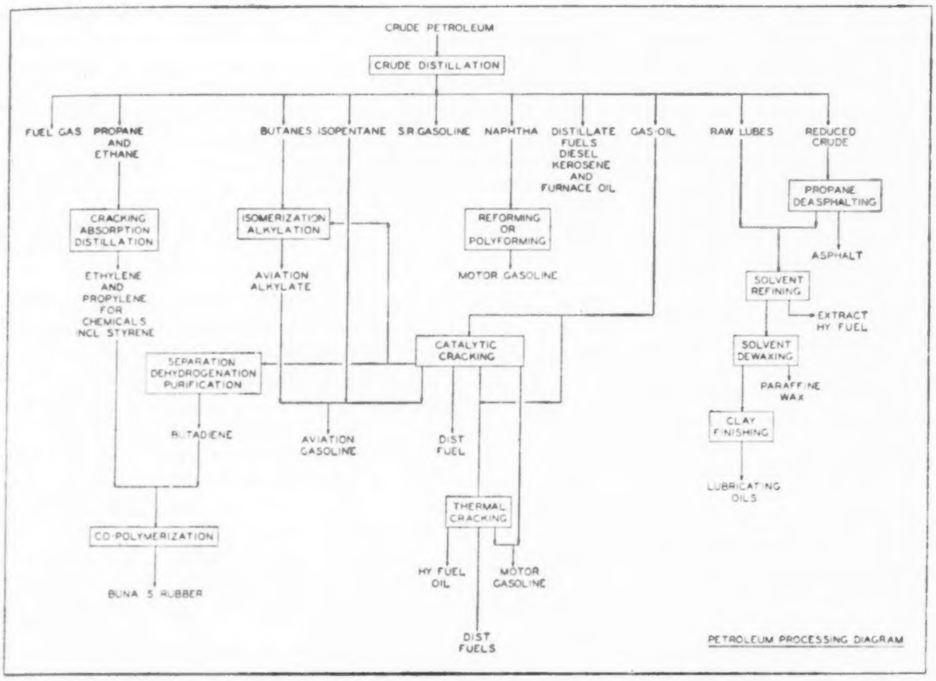

FIG. 1 SIMPLIFIED PETROLEUM-PROCESSING DIAGRAM

liquid, these units require the mechanical handling of catalyst in large volumes. The use of the gas turbine in Houdry units, the generation of steam in catalyst regeneration, and the mechanical problems of handling large volumes of catalyst all offer interesting problems and developments.

Comparison of the temperature-pressure level trend in the various methods of petroleum-refining processing is interesting here as it forms an index to the design and maintenance problems of the engineer. These levels encountered in various processes are listed in Table 1.

TABLE 1 TEMPERATURE-PRESSURE LEVEL FIGURES FOR VARIOUS REFINING PROCESSES

	Typical operating Temp, deg F	Typical operating Pressure, psi
Thermal gas oil cracking	950	1000
Thermal naphtha reforming	1000	1000
Polyforming	1100	1600
Catalytic cracking, reaction	950	Atm.—50
Catalytic cracking, catalyst regeneration	1100	Atm.—50
Catalytic cracking, steam generation	450	450
Catalytic cracking, gas turbine	900	40

The "Houdry" catalytic-cracking process utilizes the fixed bed with synthetic or natural catalyst, and most plants employ from four to twelve catalyst cases. The switching of cases from on-stream to purging and regeneration of catalyst is accomplished by an automatic synchronized valve-timing system. A molten heat-transfer salt serves for cooling during the carbon-burning cycle and for heating during the cracking cycle. The "thermofor" catalytic-cracking process is continuous with a moving-bed type of operation, having one chamber for the reaction and another for regenerating the catalyst. The "fluid process" is a continuous moving-catalyst operation, utilizing a finely powdered catalyst which is maintained in an aerated or fluidized state and which exhibits flow properties similar to liquids.

These last two processes introduced the problem of circulating large volumes of catalyst (in addition to the usual liquid and vapor circulation); pelleted, chemically treated natural clays, and synthetic-bead-type catalyst in the Thermofor process, and pulverized chemically treated natural clay and synthetic in the fluid process. The volumes circulated vary from 100 to 150 tons per hr for the former at a catalyst to oil ratio of about 2 to 1, and up to approximately 1500 tons per hr for the fluid process, at a catalyst-to-oil ratio of 13 to 1 by weight.

In the thermofor unit, the catalyst is moved from the bottom of the reactor to the top of the Thermofor kiln and from the bottom of the Thermofor kiln to the top of the reactor by specially designed continuous-discharge vertical-lift bucket-type elevators. The fluid process moves the catalyst from the reactor to the regenerator and from the regenerator back to the reactor by the gas-lift principle of balancing a stream of high solids density flowing downward against a stream of low solids density flowing upward. This catalyst flow system, as well as the separation of dust from gases, represents an ingenious engineering development.

In regenerating the catalyst, the Houdry unit uses a molten-salt transfer system for cooling during the carbon-burning cycle and for supplying heat during the cracking cycle. This transfer of heat is obtained by pumping the molten salt through vertical fin-tube elements distributed throughout the various catalyst beds. In the Thermofor unit, the carbon deposited on the catalyst is burned off in stages in the multiple-zone Thermofor kiln. The heat of combustion is removed largely by the vaporization of boiler feedwater for the production of 450-lb steam. Air for combustion is compressed to approximately 2 psi in a centrifugal blower and may be heated to any desired degree in an air-line burner before passing into the various burning zones of the Thermofor kiln. The temperature levels of the catalyst in the various zones are held to a level of approximately 1100 F maximum by the generation of by-product steam in quantities of 20,000 to 60,000 lb per hr for the 10,000 and 15,000-bbl per-day units, respectively.

The spent catalyst in the fluid plant flows from the spent-catalyst hopper through a clay leg, where it is contacted with air, and then flows into the regenerator where the carbon deposit laid down in the reactor is burned off. The efficiency of contacting of gases and catalyst is a function of the degree of turbulence obtained. The temperature of the regenerator is controlled by circulating catalyst from and to the regenerator through heat exchangers.

HOT-CATALYST ELEVATOR

Some details of the mechanical features of the continuous-discharge vertical-lift bucket-type elevator are presented here because of their general interest to mechanical engineers.

The development of the hot-catalyst elevator (catalyst temperature 950–980 F) is unique in several respects. Their approximately 200-ft centers far exceed the heights of bucket elevators in other industries. The high operating temperatures required careful selection of appropriate materials. Continuous operation periods of several months between shutdowns and the absence of any "spare," required extraordinary durability in all details. The elevator casing, supported within its own tower structure, had to be reasonably gastight while yet retaining all necessary provisions for expansion. An inert atmosphere of hot flue gas is maintained within the elevator casing.

To avoid unnecessary damage and degradation of catalyst, an elevator of "continuous-bucket" design running at slow speed was preferred. An elevator consisting of two strands of 12-in-pitch chain with a continuous line of buckets, supported between the chains, was selected. The buckets are principally of 10-gage special-specification steel to resist heat, and proportioned so as to reduce discharge spillage to a minimum.

Chain proportions were selected to show a factor of safety, ultimate to working strength, of about 10 to 1 under operating conditions and after reasonable wear had occurred. Unit pressures in bearing surfaces were held within the conventional values for elevator chains.

Special chrome-moly alloy steels are used with varying alloy and carbon and heat-treating specifications to suit the component parts of the chain. The bushing is a high nickel-chrome alloy iron chill-cast, heat-treated, and ground. The ultimate strength of the chain is 200,000 lb, for a designed working load of 15,000 to 18,000 lb, and a weight per foot of chain of $25^1/_2$ to 28 lb.

The elevator chains expand considerably (up to about 16 in.) in operation and the foot shaft and related parts are arranged to compensate accordingly. A total of 30 to 33 in. of vertical travel is provided for thermal expansion and chain wear.

CATALYST CIRCULATION

With regard to erosion, it was anticipated that the continuous circulation of large volumes of high-temperature catalyst either pelleted, beaded, or powdered, would result in erosion of chutes and lines to some extent, probably as a function of the velocity. Where and to what extent erosion would occur could be anticipated only from pilot-plant operation, which is not conclusive for commercial-size plant where the slope of lines, obstructions to smooth flow, and mechanical joints are also factors. The points of most severe erosion occurred where (1) the catalyst had a free flow in partially filled gravity lines permitting high velocities and impingement on opposite wall, as at sharp turns or mitered bends; (2) where thermowells had been introduced across the line of flow causing eddy currents; (3) any arrangement of equipment which causes a jet effect resulting in high-velocity blasting against surfaces.

It was found that erosion for both processes could be greatly reduced by streamlining the piping.

GAS TURBINE

The fixed-bed catalytic-process Houdry units utilize the gas turbine in all their installations. The first units installed were the earliest commercial application of the gas turbine in the United States. The gas-turbocompressor units used had general specifications as given in Table 2.

The earlier units were built by Brown-Boveri and the later units by Allis-Chalmers. The units consist of an axial-flow turbine directly coupled to an axial-flow 20-stage air compressor. Approximately 85 per cent adiabatic efficiency is obtained discharging the flue gases at a few inches of water to the stack at 600 F. No air preheat is attempted. These units were successful and are still in operation. Some maintenance was required for the blades owing to erosion from dust brought in by the air. The 60,000-cfm unit met some vibrational problems due to the 5-in-long blade from root to outside going into the fifth harmonic. This was corrected by lacing wire on the blades.

TABLE 2 SPECIFICATION FOR GAS-TURBOCOMPRESSOR UNITS

Capacity compressor unit (based on 60 deg), cfm	23000–60000
Suction pressure (based on 60 deg)	Atmospheric
Discharge pressure, psig	45
Turbine gas quantities, 40000-cf size, lb per min	3170
Pressure, turbine inlet, psig	40
Temperature, turbine, inlet deg F	800–950
Speed of set, rpm	5180
Weight of set, 40,000-cf size, lb	70000
Horsepower	3000–5500

The use of the gas turbine in supercharger work at higher temperatures is now of great interest. In this service, chromium-tungsten-cobalt alloys with titanium and columbium stabilizers will be utilized where temperatures will range from 1600 F on up perhaps to 2000 or 2200 F. The alloys used for the catalytic-cracking turbine blades are 8 per cent nickel steel which has been satisfactory for the operating temperatures used.

RENEWAL OF HIGH-OCTANE PRODUCTION

When the octane race is revived once more, with sufficient lead available, many refineries will be required to reform more naphthas or install catalytic-cracking capacity to meet the octane levels predicted. It is interesting to note that the demand for premium-grade gasolines greatly increased during 1946, as compared with prewar years at a ratio of regular to premium of 50–50 as compared with 85–15 in 1941. This was true even before the Civil Production Administration in April, 1946, issued the order reducing the amount of metallic lead allotted to the oil industry.

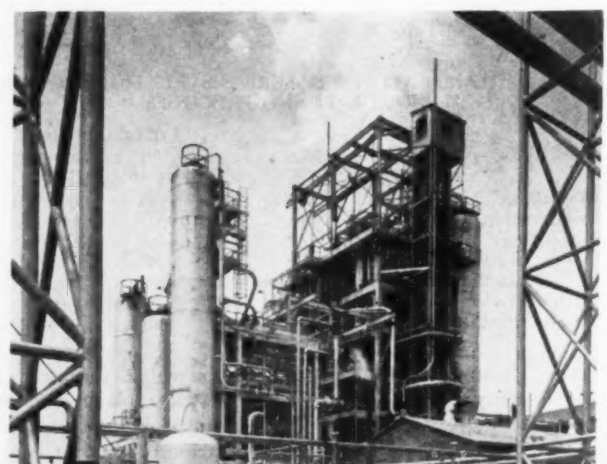

FIG. 2 POLYFORM CRACKING UNIT FOR MANUFACTURE OF HIGH-OCTANE GASOLINE

Present-day automobiles have compression ratios which range from 6.5:1 to a top 1942 level of 7.5:1. The oil industry is capable of producing motor fuels of even higher octane, and it is generally believed that the automotive manufacturers will take advantage of this fuel. While their newer models may be late in reaching the roads, it is expected that engines eventually will be manufactured with compression ratios perhaps as high as 8 or 9 to 1. The designs will no doubt be based upon economy of consumption of gasoline, freedom from knock, with acceleration and power. Automobile manufacturers may utilize some of the new magnesium and aluminum alloys in their chassis and body designs, but it is believed that the American public is still more interested in acceleration and power than it is in economy of gasoline consumption.

Fig. 2 shows a Polyform unit where temperatures of 1100 F and pressures as high as 1600 psi at the outlet have been used in the cracking furnace. This unit converts low-octane naphtha, propanes, and butanes into high-octane gasoline, some of which was used during the war to furnish high rich-mixture aviation blending stock.

AVIATION GASOLINE

In the field of aviation gasoline, the prewar consumption of 35,000 bbl per day is compared with a level of approximately 125,000 bbl per day 10 years hence. For military use, there may be some need for superfuels having octanes over 100; however, present indications are that there is little to be gained. Jet-propulsion engines, designed to move planes at sonic speeds, appear to be displacing gasoline-powered radial engines employed in military pursuit and attack planes. It appears that kerosene-powered jet-propulsion engines will eventually completely displace gasoline-powered radial engines for nearly all military aircraft except possibly heavy bombers and reconnaissance planes. Even in this field as well as in that of large commercial craft, they may find application, particularly as metallurgical research provides the materials to permit higher temperature operation and improves the efficiency of jet-propulsion units.

Some interesting mechanical problems were associated with the wartime production of the 550,000 to 600,000 bbl per day of this fuel. Fig. 1 shows the use of catalytic-cracked base stock, aviation alkylate, and isopentane for the production of aviation gasoline. In the production of aviation alkylate, sulphuric acid, or hydrofluoric acid (anhydrous hydrogen fluoride), is used as the catalyst. The acids are circulated in direct contact with butane-butylene stocks. Hydrofluoric acid vaporizes at atmospheric conditions, is highly injurious to the human body, and attacks rapidly silicon compounds, thus presenting many problems in corrosion resistance and leak prevention.

In general, mild or killed carbon steel for high concentrations and temperatures up to 150 F have been found adequate. It is necessary to avoid slag inclusions and secure sound welds by x-ray inspection. API ring joints are used where flanges are necessary. Pump-gland leakage is overcome by continuous injection of nonacid flushing stock, followed by double mechanical seals or packing boxes with lube-oil circulation. Valving is selected on its ability to prevent leakage. On the original installations, Hyperseal plug cocks were used principally because stem packing is not required. As a result of operating experience, however, carbon-steel valves with Monel trim appear most promising. Silver seals for bursting heads or relief valves have been satisfactory. Steel castings must be sound. Small sand inclusions are rapidly eaten out and acid will travel through the casting and appear outside some distance from the internal starting point. Seamless-steel pipe has given trouble-free service. The acid dehydration column is fabricated of silver-clad steel, with silver gaskets, one of the very few materials resistant to a 50-50 water-HF acid mixture at temperatures of 250 to 300 F. All vents, drains, and relief valve discharges are connected to a closed system and exhausted through a neutralizing tower.

DISTILLATE FUELS

With regard to distillate fuels, as pointed out earlier, the first half of 1946 witnessed a proportionately greater increase in civilian consumption in the United States of kerosene, heating oil, Diesel oil, and other distillate fuels. This may be accounted for in part by the substantial deficiency of both distillate and residual fuel oils during the war years. There is an increasing demand for the use of distillate fuels for home and industrial heating as well as for stationary and mobile Diesel-powered units, largely as a result of war stimulation. The average demand for distillate fuels during the 5 years preceding the war increased by about $8^1/_2$ per cent annually, indicating the rapid growth in the use of these fuels for domestic and industrial heating. Diesel engines have increased from 5,000,000 to 45,000,000 hp during the war years primarily for military vehicles and naval vessels, as well as for civilian use. The continued use of Diesel locomotives seems certain even for passenger service and heavy freight. Its use will be extended in farm tractors and truck and bus service. Home-heating oil requirements will show a tremendous increase with the new home-building program scheduled as well as the backlog of conversion from coal to oil from the war years.

The rapid increase in distillate-fuel requirements will be met partly by the use of catalytic-cracked distillates and partly through increased refinery crude throughputs. Catalytic cracking of a large quantity of heavy material which in the past found its way into residual fuel oils will provide a significant part of the increased motor-gasoline and distillate-fuel requirements. However, it will probably result in a deficiency in residual fuel-oil supply.

It is expected that the demands of increased industrial activity will bring about increased requirements for residual fuel oils, and that any deficiency will be met by additional crude throughputs. It is probable that these additional crude runs will be marginal crude made up largely of imported low-gravity crudes. The refining industry should encounter no difficulties in balancing market requirements for fuels for the next 2 years with existing catalytic cracking, coking, deasphalting, and vacuum-reduction facilities, and the units now under construction.

LUBRICATING OILS AND WAXES

While there was a vast program for expansion of refining facilities mainly for the production of aviation gasoline during the war years, very few new facilities were constructed for the manufacture of high-grade lubricating oils. This was because it was possible to meet the military requirements for lubricating oils with existing plants. The war has been responsible for many factors influencing the present lubricating-oil picture. The use of higher compression-ratio engines, higher speed machinery, and Diesel engines has stimulated the trend in the refining industry for the production of higher quality lubricating oils. The refiners are producing these lubricating oils with increased flexibility and maximum yields from crude at minimum costs. At present the daily production of lubricating oils in the United States is in the order of 120,000 bbl. A large program of construction of new solvent deasphalting, refining, and dewaxing plants for high-quality lubricating oils is now under way with approximately 35,000 bbl per day finished-oil capacity. It is estimated that approximately two thirds of this capacity is for replacement of obsolete process methods and one third is increased lube-oil production.

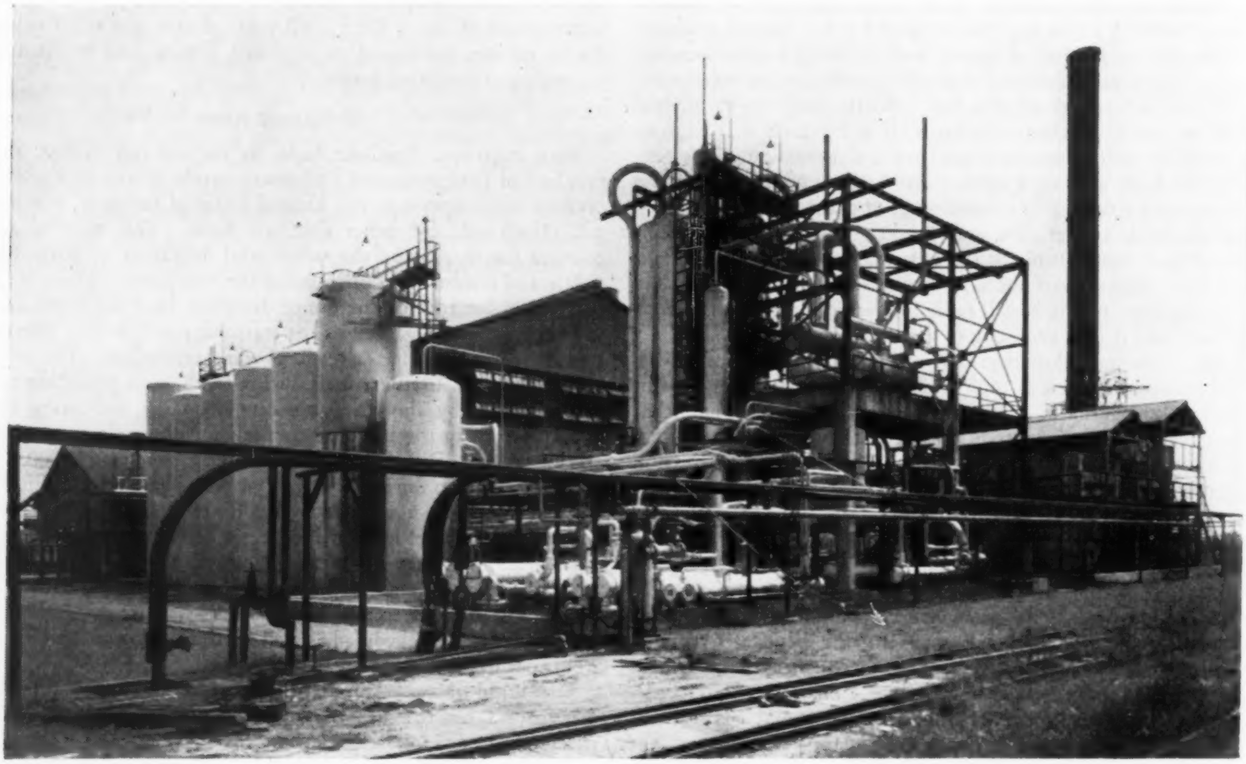

FIG. 3 SOLVENT-DEWAXING PLANT

The installation of propane deasphalting units and efficient vacuum units is for obtaining maximum yields of lube-oil stocks and for giving flexibility in balancing viscosity requirements. Solvent refining removes objectionable compounds from raw lube stocks and improves viscosity index. Solvent is introduced into the top of the extractor and contacts countercurrently the raw lube stock rising up through the tower. The raffinate is removed overhead and the extract from the bottom of this tower. These extract and raffinate solutions are then processed for the recovery of the solvent. The percentage of finished lube oils using solvent-refining has now increased to approximately 50–60 per cent of total production. The use of additives, which development went forward rapidly during the war, has become an important part of lube-oil manufacture, particularly emphasized by design trends and service requirements. These additives include antioxidants, pour depressants, viscosity-index improvers, detergents, foam inhibitors, corrosion preventives, and those resulting in increased oiliness and film strength, decreased engine deposits, and ring sticking.

The war also was responsible for simplification of specifications for lubricating oils, decreasing the number of oils required. Heavy-duty oil is one illustration. Other war developments were a marine-turbine oil which was nonrusting, an aircraft hydraulic fluid with high viscosity index up to 200, chemical properties which would permit the use of synthetic-rubber gaskets that would maintain high oxidation stability and be noncorrosive to various alloys, and a jet-engine lubricant which would be entirely volatile at the operating temperatures and show low viscosity for high-altitude flight and engine-starting.

Solvent dewaxing for preparing low-pour specification lubricating oils and marketable waxes are further replacing obsolete processes and improving the quality of both products. Fig. 3 shows a solvent-dewaxing plant where a solvent-waxy lube-stock mixture is chilled to such temperatures as —20 F and continuously filtered over rotary vacuum filters, removing a pressed-oil solution and a slack-wax mix. These streams are then processed for the recovery of the solvent.

The war stimulated the demand for microcrystalline waxes to a volume of 120,000,000 lb per year. These waxes played an important part in the military packaging program, and it is expected that they will find an increased peacetime market as a result of the new uses developed during the war period.

Sweating for the production of crystalline waxes may be supplemented by water-emulsion wax-deoiling units for increasing production of existing sweaters. In solvent dewaxing, a reverse-sequence method for simultaneous production of marketable waxes along with low-pour lubricating oils is new. The practice of chilling wax out of a rich oil-lean solvent solution results in the production of harder, more satisfactory crystals which contain less oil and yields a more highly refined product with lower solvent requirements. Continuous production of wax together with lubricating oils by this method shows an attendant saving in tankage and has operating advantages. A new application in this field is the use of centrifugal propane compressors for refrigeration at levels of —30 F, with a refrigeration tonnage of about 600–800 tons.

Improvements in lubricating oils made during the war have resulted in longer life for automotive and airplane engines, greater speed and protection of instruments, improved metal-cutting methods, better aircraft lubricating, and better performance in hydraulic power transmission.

CHEMICALS

The field of chemicals from petroleum received great impetus during the war with the tremendous developments in the

production of synthetic rubber, toluene, and explosives. During 1944, approximately 3,000,000 lb of chemical raw materials were produced from petroleum, doubling the 1943 production. It is estimated that chemical, pharmaceutical, and cosmetics manufacturers will invest $1,000,000,000 in expanded facilities during the next 5 years. A substantial percentage of the raw materials which will be processed in these industries will originate from petroleum. Chemical raw materials produced in large volumes from petroleum are cheap and such products as ethylene and propylene, used in the manufacture of plastics, alcohols, and other synthetic organic chemicals, are already in large-scale production. During 1945 more than 1,000,000,000 lb of ethylene and propylene, roughly in equal proportions, were used in the production of synthetic organic chemicals. Large new plants for the further production of ethylene and propylene are now under construction.

Fig. 4 shows an ethylene plant where propane is cracked for the production of ethylene, which is recovered by reboiling absorber and low-temperature fractionation. These plants, primarily using refinery-fuel-gas or natural-gas constituents for starting materials, but also some gas oils or reduced crudes, have offered interesting mechanical problems. Low-temperature fractionation at temperatures as low as —150 F and pressures up to 500 psig are used in some ethylene-recovery systems. Propane refrigeration is used in one plant at a suction pressure of 3 psi and a discharge pressure of 210 psig at a temperature level of —35 F.

The cracking of ethane and propane for production of ethylene and propylene, while carried out at low pressures, requires high temperature levels in the range of 1350–1450 F, and a uniform heat transfer over the entire tubular periphery for minimum carbon formation. Tube materials used for this service are 18–8 stainless steel, columbium, or titanium stabilized, and 25–20, as well as 25–12 Cr-Ni steels.

Interesting mechanical problems were also encountered in the plants built during the war for the production of butadiene and styrene, which raw materials are used to produce Buna-S rubber used in automobile tires. The dehydrogenation of normal butylenes to butadiene requires reactor design incorporating materials to withstand high temperature levels up to 1400 F, and proper distribution of reacting materials with the catalyst. Careful vacuum distillation with minimum exposure of easily polymerizable materials were necessary for styrene manufacture. Extractive distillation and the use of 100-deck towers were required for many of the separations in the production of butadiene. The butane-butylene feed stock cut is first separated into normal butylenes, then dehydrogenated to butadiene in fixed-bed catalytic reactors, and finally concentrated to high-purity butadiene.

CONCLUSION

Developments now under way and to be further encountered in plants now projected for the production of gasoline, Diesel oil, and oxygenated compounds, including alcohols from natural gas, are of great interest to petroleum technologists. Interesting developments came from the 63,000,000 gal of nitration-grade and 34,000,000 gal of aviation-grade toluene which were manufactured from petroleum in 1944, which was approximately three fourths of the nation's total toluene production. The processes of hydroforming (catalytic cracking a close-cut naphtha with recirculation of rich hydrogen gas), SO_2 extraction, extractive distillation, and azeotropic distillation featured prominently in this accomplishment.

The petroleum industry will watch with interest developments in atomic energy as a source of power, as they may well influence the use of petroleum products. Application may be found in petroleum refining or possibly in effecting new reactions in the synthesis of hydrocarbons.

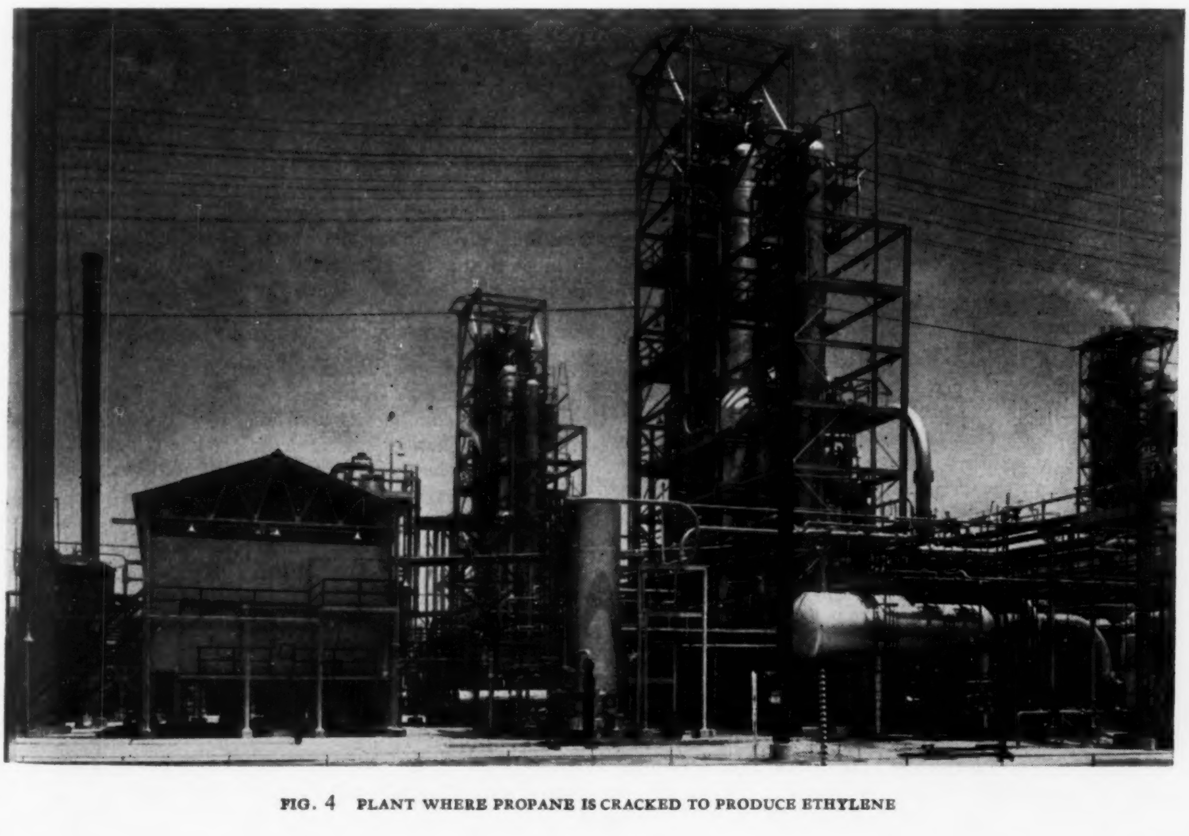

FIG. 4 PLANT WHERE PROPANE IS CRACKED TO PRODUCE ETHYLENE

FRENCH INDUSTRY *and* RECONSTRUCTION

By A. A. LUEBS

MECHANICAL ENGINEERING DEPARTMENT, UNIVERSITY OF NEBRASKA. MEMBER A.S.M.E.

THE central aim of French governmental policy today is so to rebuild and revitalize France that she can take her place once more among the world's great powers, not as an equal in military strength (for her leaders realize that a small country of 40,000,000 population cannot compete with present-day Russia or the United States in matters so dependent on gross physical size), but as an equal in over-all technological stature and in national standards of living. Such a rebuilding project is at every step dependent on or at least connected with industry, and for that reason the outsider who wishes to understand some of the obstacles facing French reconstructionists must take time to examine the character and status of French industry, past and present.

INDUSTRIAL FACTS OF FIRST WORLD WAR

"France" to the average American connotes primarily choice wines, fine perfumes, artistic inventiveness, and the Riviera. But French industrial vigor has, in the recent past, been as much a part of the total picture as all these rolled into one. When, near the beginning of the first world war, the German Army succeeded in occupying the main iron, textile, and coal regions of France and, thereby, in withholding the productive capacity of these regions from the Allies for the war's duration, the French had yet enough machine tools and skilled factory workers to permit the creation almost overnight of a new war industry in and around Paris and Lyons. This war-spawned industry then proceeded to supply the very large French Army with high-grade material through 4 years of heavy fighting, and when the United States joined the Allies, French artillery and aircraft equipped many American units.

This tremendous manufacturing feat was really never surpassed, or indeed equaled, by French industry in the years following the war; but at the beginning of the recent war, 35 per cent of the population of France lived by industry, and manufactured goods made up 51 per cent of all French exports. Foodstuffs and liquors accounted for only 14 per cent of the export total. From even these few statistics it is not hard to see the nonsense in Hitler's claim that France was a purely agricultural nation. As a matter of fact, France is the most nearly self-sufficient in food production of all the countries in western Europe which can truly be termed "industrialized." But agriculture and industry are nearly enough equal in importance to establish the French national economy clearly as dual in nature.

PRESENT INDUSTRIAL RECONSTRUCTION NEEDS

On the basis of the facts just given, then, it might be assumed that all France must do to insure her physical rebuilding is to grease the wheels of the old well-established industry and begin at once turning out the billions of dollars of manufactured goods now needed. The assumption, however, is very far from the truth. Even discounting, for the moment, the considerable war damage sustained by various factories, French industry was far from being ready in September, 1944, to meet the enormous demands of reconstruction.

The principal shortcoming was and is decentralization. Notwithstanding the introduction of large-scale operations into the mining and steelmaking industries, most French industrial production still comes from small factories employing less than 50 men. In fact, at the height of the world depression, in the early 1930's, 40 per cent of all goods manufactured in France came from units employing less than 10 men, and this percentage had not been reduced materially at the beginning of the second world war. In other words, a collection of many small groups of skilled artisans working in neighborhood shops still constitutes the bigger part of French industrial strength. If it be asked why a nation which was among the first to undergo thoroughly the industrial revolution, and which has produced a host of pace-setting engineering specialists, should have been halfhearted in adopting modern assembly-line methods, the answer cannot be given completely in a few words. Probably the long-standing French tradition of individual craftsmanship has found the small machine shop less alien in spirit than great factories built on the American pattern. What is at least as important, France's internal market would not have justified the massive scale of German and American industry.

DECENTRALIZATION OF FRENCH INDUSTRY

However its origin is explained, decentralized industry will no longer satisfy French needs because it is wasteful of man power. Exactly how wasteful it is may be surmised from the fact that, although the number of French industrial workers in 1938, was over one third that of American workers, the production of manufactured goods in France for that year was only one tenth of American production. Today, with the French laboring classes bled white by two world wars, the cardinal problem in France is how to increase the productiveness of the individual man. In the factories this increase must come about through introducing the latest methods of unified mass-production.

FIVE-YEAR PLAN FOR AUTOMOBILE INDUSTRY

French engineers and national planners realize full well what should be done (as evidenced by The Monnet Plan[1]), but without considerable monetary assistance from outside the country, no sweeping changes can be made. What is being attempted on present slender resources is well illustrated in a new five-year plan for the automobile industry.

Before the recent war, 300,000 men were employed in France in the manufacture of automobiles, and the industry was well established; but the efforts of this sizable labor force were dissipated in the hand-making of what in many cases amounted to but a few score vehicles of each of 170 widely varied types, models, and styles then being offered. Because these hand-made cars were too expensive for most Frenchmen to own, the prewar industry easily supplied the national market. Today the demand for new cars and trucks has increased enormously

[1] "The Monnet Plan," *The Economist*, vol. CLI, no. 5390, Dec. 14, 1946, p. 954. (See pages 309 and 310 of this issue.)

in France just as it has in the United States, and the demand is far beyond the capacity of the old industrial order.

Since it is not immediately possible to erect totally new assembly-line factories modeled on those of Detroit, the 5-year plan provides mainly for the more efficient using of what factories now exist. The various independent automobile manufacturers are asked to forget about normal competition during the 5 years and merge their productive capacities for the large-scale manufacture of twenty-four vehicles, i.e., eighteen truck types and six passenger-car models. With designs limited and standardized, the making of individual parts for these selected models can be "farmed out" to the many small shops throughout France, and the latter will, in turn, restrict their activities to the making of just their assigned parts. Large stampings and forgings, as well as the actual assembling of the vehicles, will be confined to the few existing large plants. Materials being available, it is expected that within 5 years this plan will restore France to her 1938 circulation of light motorcars and trucks.

NEW TOOLS AND MACHINERY REQUIRED

But American onlookers would be ill-advised to accept this paper solution as a complete triumph of skillful management over material deficiencies. Even if the 5-year plan fulfills its authors' expectations, it will only supply the French market with 1938 automotive style and engineering, and that in a very limited, abridged form. Moreover, there can be no real advance beyond the prewar level of achievement in the automotive or any other French industry until new machinery and new methods are put to use on a widespread basis.

To understand fully how much new manufacturing media are needed, it must first be recognized that French industry was badly run down before the last war began. The repair of physical damage wreaked by the first world war so completely absorbed French money and effort from 1918 to 1938, that little was left over for making fundamental industrial improvements. What did remain was wiped out during the depression of the 1930's or dissipated by an increasingly rotten French governmental bureaucracy. It is not, therefore, hard to explain why the average age of French machine tools is now over 25 years (in the United States the average is 6 years), but French planners have found it very hard to arrange for the total replacement of this antiquated equipment. Naturally, the United States is being looked to for the necessary loans with which to pay the costs.

ADVANCED ENGINEERING AND RESEARCH LACKING

The planners are also hard put to help their industry make up the ground lost in general scientific research during the German occupation of France, 1940 to 1944. In the United States, during those years, research made unprecedented strides forward in all departments because of prodigal government financing. The resulting inventions and new manufacturing methods, though developed to strengthen a nation at war, are proving even more valuable in peace. Certainly American industrial stature increased sizably during the war. In France, on the other hand, industry and pure science stagnated, and it is not likely that even intelligent national control and liberal funds for research (if and when available) could enable France to catch up with the United States unless the latter chooses to share her present store of engineering advances.

Whatever may be done to increase the efficiency of French industrial organization, to replace antiquated machinery, or to regain lost ground in scientific research, there is yet one more obstacle to be passed—an obstacle which no amount of money or careful managing can hope to eliminate, at least for the time being. France has never had adequate sources within her boundaries of most of the raw materials needed for industry. From its earliest beginnings, French industry has had to import more than three fourths of all its needs in coal, copper, manganese, cotton, zinc, wool, chrome, cellulose, and lead. It is true that deposits of iron ore, bauxite, and potash in France are sufficient to supply domestic requirements and to allow for some export in addition. In fact, French prewar-mined iron ore tonnage was over one half that of the United States, and her bauxite production far exceeded that of any other country. But a self-sufficient industry cannot exist on these few miscellaneous minerals. Moreover, iron ore is useless to local industry without coke to smelt it, and most French coal is of too poor a quality for making metallurgical coke. So, viewed from any angle, France is unalterably dependent upon other countries for industrial materials, and this dependency places considerable strain on the national economy.

To be sure, France can and will hold down her consumption of coal (1) by realizing to the fullest extent her water-power resources (which are considerable), and (2) by using thermic power more efficiently. The latter may be accomplished by abandoning the present system of thousands of small autonomous power plants in favor of a single, nation-wide, electric network, supplying the whole of France from a combination of large steam and hydroelectric generating installations. Not only is the electric network the most efficient means of distributing power, but the central steam-generating stations can burn the low-quality French coal economically. Most of the present independent steam power plants must use better-grade coal. Any reduction in the national consumption of foreign coal which can be made without holding down industrial productivity or otherwise lowering the standard of living is of definite advantage to the economic health of France.

FRANCE DEPENDENT ON WORLD TRADE FOR RAW MATERIALS

Since, however, most imports of raw materials must continue indefinitely, and since these materials must be paid for in accepted international exchange, it is quite clear that France must, in the years to come, take an increasingly active part in international trade. Without exports, there will be little income in foreign currency.

Before the second world war, France paid with exports for about 62 per cent of her imports. The other 38 per cent was covered by the invisible trade account (largely shipping), income from foreign securities, and by the expenditures of foreign tourists. Today—and these conditions will persist in part for some time—French shipping is all but extinct, her foreign-security holdings are very low (because most of the securities were sold out at the start of the war to obtain money), and it will be some time before the prewar tourist traffic can be revived. So it is obvious that this other 38 per cent must now be supplied largely from new sources, and the only likely source is income from exports. These exports will continue to include, as before the war, vintage wines and other luxury items, but only with manufactured goods can France hope to attain the volume of sales necessary to pay for purchases from other countries.

Income from manufactured goods sold outside the country must support yet another French venture, if current negotiations for reconstruction loans from the United States are successful. Such loans are, as can be seen from the preceding discussion, absolutely necessary to the recovery of France's industry, and in turn, only the remodeled reincarnated industry which the loans may make possible can hope to pay off the debt. The relationship here is a delicate circular one, but if France can find markets for her manufactures all will be well.

(*Continued on page 305*)

Is It Good-Bye to the ATTIC GENIUS?

By JOHN W. KITTREDGE

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MANY years ago in "Merrie England," it was the custom for the king to grant monopolies on various wares. For the sole and exclusive privilege of selling the specified commodities, the person so privileged paid a certain per cent to the king, a "royalty," so named because it was paid to the royal personage. These monopolies were very fine for the holders thereof and for the king, but very burdensome to the public at large who had to pay monopoly prices for what they ate and wore.

In 1601 the good Queen Elizabeth declared most of these monopolies to be void, excepting, however, monopolies granted for discovery and invention. In 1603 the court held that "in such case, the king may grant him a monopoly patent." This later became the famous "statute of monopolies of 1623." In 1624 Parliament enacted it into law and King James signed it, "the Magna Charta of rights of inventors," still in force. The court called it a monopoly patent, and didn't beat around the bush about it. It was "for the good of the realm," in payment to any man who "by his own charge (at his own expense) and industry or by his own wit and invention doth bring any new trade into the realm."

After it had operated successfully for 150 years, our own forebears provided similar monopolies in our Federal Constitution for authors and inventors, the only monopolies that they provided for. They provided: "The Congress shall have power to promote the progress of science and useful arts by securing for limited times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries." Constitution of the United States, Article 1, Section 8.

CONSTITUTIONAL RIGHTS OF AUTHORS AND INVENTORS

While they did not use the word "monopoly," they gave Congress power to promote such progress solely and only "by securing for limited times to authors and inventors the *exclusive* right," a monopoly, nothing more and nothing less. In our language, "securing" doesn't mean "catch as catch can and the devil take the hindmost." It means actual protection to scientific property equal to the protection the law gives to our homes and stores and warehouses. "Exclusive right" doesn't mean that a patentee must sell to certain persons and not to others, at a certain price and for a certain purpose. It means he can sell to whom and at what price he pleases. Note that this is Constitutional Law and that it was law a hundred years before John Sherman and his antitrust law were heard of. Note also that this monopoly is for a limited time only; that at the end of that time, the invention goes to the public for eternity.

We have advocated, and we still hold, that large revenues from patents should go to a large number of small stockholders; should help to make a large number of people independent, rather than make millionaires of a few. But this would in no way impair the validity of the patent. The patent itself and its earning power should be inviolate. (With all due respect to the authors, we will consider the inventors only.)

IMPORTANT INVENTIONS

Let us consider for a moment what a few inventors have given. In England in 1714 the "commissioners for the discovery of longitude at sea" offered a prize of 20,000 pounds sterling ($100,000) for means to determine longitude within 30 miles. In 1728 John Harrison exhibited a timepiece. About 1735 he showed another and was given 500 pounds with which to carry on. In 1761 he came before the board with a fourth timepiece. The board paid him 5000 pounds in 1762, 5000 in 1764, and 10,000 pounds in 1769. Harrison was then 76 years old. He had worked 41 years from the completion of his early model (probably it was not his first); had given all the active years of his life to his invention. The record does not indicate any "flash of genius." It is interesting that no other inventor fulfilled the requirements in the meantime. But the chronometer determined longitude within 18 miles, and did much to make England the "mistress of the sea" (until the United States came).

Peter Cooper built five miles of railroad, and on a certain eventful day was to try out his locomotive. For a certain distance the stage road paralleled the railroad, and there the stage company had a coach with a relay of its best horses in waiting. Presently, the engine appeared, Peter himself at the throttle, with a crowd of men and boys running alongside and keeping up with him. The stage driver cracked his whip and the race was on. Peter threw on a full head of steam and ran ahead of the stage. But under this severe strain, the engine broke down and, as the stage sped past with hats and handkerchiefs waving, it was thought that a railroad would never again be heard of.

Nowadays, we work faster, but more agony is crowded into fewer years. In the first automobile race in this country in 1895, Duryea drove approximately 55 miles in 8 hours, about 7 miles per hour.

"There were five other cars in the race. The only one of them to finish was an imported Benz, piloted most of the distance by Oscar Mueller, but actually driven over the finish line more than an hour and a half after Duryea by Charles B. King, the umpire passenger, after Mueller had collapsed from exhaustion and lost consciousness."

EVOLUTION OF THE AIRPLANE

In 1809 Sir Roger Cayley worked theoretically and experimentally on the airplane, and in his notebooks appear the first crystallized precepts of airplane performance. He realized that the engine must be lighter than any then known and not only suggested, but tried to build, an engine in which the "transfer of energy is brought about by exploding gas within a cylinder." Nearly a century later, in 1891, Otto Lilienthal became the first man really to fly. Then he built a carbonic-acid-gas engine weighing 90 pounds and developing 2.5 horsepower but, unfortunately, he was killed before he could test it in flight. Pilcher, a student of Lilienthal, carried on his work. He built

a 4-horsepower engine but he, too, was killed in 1899 before he could test his power-driven plane.

In 1896, "Langley demonstrated a power-driven model with a 30-pound steam engine. His model was successful in making flights up to one-half mile." During the 1890 decade, many men worked on airplanes, did creditable work, and work that would have been successful but there was not at that time an engine sufficiently light and with sufficient power to drive a man-carrying plane. Langley's plane met with several mishaps and, his finances exhausted, he abandoned the work.

After Langley died, Glen Curtis put an improved engine in his plane and flew it. In the late 1890's and early 1900's, improvements in engines were made that enabled the Wright Brothers at Kitty Hawk in 1903, to make what is generally conceded to be the first successful flight. The first flight lasted 12 seconds; the fourth lasted 59 seconds, and the plane traveled 852 feet. But aviation still had a long way to go. "The period 1909 to 1915 was for America the real incubation period. Many inventors became interested in aviation, but development was slow."

Columbus found rubber in the Americas and took specimens of it back to Spain. Many were the attempts to make it usable, but it was hard and breakable in winter and soft and sticky in summer. Charles McIntosh coated two pieces of cloth with it and then put the sticky sides together. In 1923, he established a plant in Glasgow to make his product, and waterproof coats still bear his name. Some 350 years after rubber had become known to white men, Charles Goodyear, after untiring efforts, gave us vulcanized rubber, a basic material of our civilization. His patent was in 1844.

TALE OF THE ZIPPER

These and many other examples show at what cost many inventors have given their inventions to the public and, as stated, given them for all time. Nor is such effort and sacrifice given on epoch-making inventions only. The zipper or hookless fastener, now worn by all of us, was patented in 1893 by Judson. When visiting the Chicago World's Fair in 1893, Col. Lewis Walker obtained an interest in it, and he then made it his lifework. During the next 20 years, he spent his own money on it and everybody else's he could get hold of, organized and reorganized, getting a fresh start now and again, but he kept going when Judson and his early associates had dropped out. All of the early fasteners were of mail-bag size, were not strong enough because of fundamental design, and the cost was prohibitive. Up to this point, no one visualized the small, neat, strong closure of later years.

Finally a Swedish engineer, Sundback, became interested with Walker and accomplished the development that set the stage for success. The first zippers were sold by peddlers in 1917. From 1918 on, they were sold on galoshes and luggage. About 1927, after more than thirty years of struggle and failure and try again, the zipper became popular and highly profitable. Sales were phenomenal. They doubled each year for three years and kept on doubling. Now zippers are used everywhere.

Such is the "progress of science and the useful arts" that our forebears sought to "promote." Men give their lifework and, in many cases, their lives actually to their developments; and they are not taking anything from the public. They are giving something to the public that it never had before, and giving it for all time. When men work out such a development at such cost, it is rightfully and morally theirs without the benefit of any law. It is not only morally right, but it is good business for the public to pay them for the service rendered. Our forebears provided modest pay by giving them a monopoly for a limited time. It would seem reasonable that that limited time should be for the inventor's lifetime, especially as many inventions do not come into their own until the inventor is old or, in many cases, until he is dead and gone. But our United States law says 17 years. Surely, to give the inventor a real and exclusive monopoly for 17 years is the least that justice could accord him; the public then to get for eternity, as long as time shall last, what the inventor, by his genius and effort and perseverance and sacrifice, has given it.

It is decidedly interesting that while the promotion of science and the arts useful to the general public was uppermost in the minds of the framers of our Constitution, they proposed to accomplish it by playing absolutely square with the inventors and development men; "by securing for limited times to . . . inventors the exclusive right to their . . . discoveries." They saw that the development men, if protected, could produce for the general public; that the welfare of such men and the welfare of the public were identical.

INVENTIONS AS BUSINESS PROMOTERS

After reciting the evils of patents through several columns of print, Judge Jerome Frank says:[1]

"Paradoxically, a patent monopoly—the antithesis of competition—can sometimes desirably promote competition. Consider Goliath, Inc., a giant corporation dominating an industry. Goliath, Inc., does not want to develop or push any new processes. If it did, it would have to scrap its old inefficient factories. But along comes Mr. David, an outsider, with an invention, which he patents, for a revolutionary process .... David forms a company, David & Company, and persuades some of his friends to invest in it. The David Company prospers. Goliath is now forced to compete with this little company. Instilled with fear of other potential competitors who may be similarly armed with patent monopolies, Goliath, Inc., will, in the future keep on its toes. It will expand its research department, which will undoubtedly make important discoveries. The patent owned by David was his slingshot. If he lacked a patent, his friends would not have taken the risk of investing in his company. Without money, he could not have competed with the giant."

Thus, in a few lines, Judge Frank tells the purpose and effect of a real patent. Here is a man, David, who thinks machines and mechanical contraptions at his meals, in his bed, at all times. He works out inventions. If he had real patent protection, he could compete with Goliath. Davids are not plentiful; one doesn't run across them every day. But there are, say, fifty potential Davids to one Goliath. That makes fifty small enterprises, where before was one giant corporation. That makes fifty different managements comprising executives, organizers, salesmen, and men of many different talents and training. That makes fifty small employers of labor. Some managements may go bad. One of them may be Goliath. The chances are that the fifty will not go bad, certainly not all at once. That makes fifty small enterprises in which middle-class people will invest small sums, and then have dividends on their investments and some part in the management, instead of buying stock in Goliath, Inc., and then trusting blindly to big management for better or worse. We think today of jobs, jobs, jobs. That will make jobs. But it will also mean working people becoming investors and managers, applying their own savings, their own brains, effort, and perseverance to industry, which is American free enterprise.

PATENT PROTECTION LACKING

In the same article[1] Judge Frank says further:

"The Supreme Court and the lower Federal courts, beginning before the birth of the New Deal and for at least fifteen years, have refused to enforce most patents."

[1] *Saturday Evening Post*, Nov. 28, 1942.

Mr. Emanuel R. Posnack tells the same thing as follows:[2]

"Indeed, due to the attitude of the courts, large numbers of patents have become no more than mere scraps of paper. For although it is the Patent Office that issues a patent, it is the courts which pass on its validity when it is brought to test; and more often than not the courts decide that patents are invalid and hence worthless. . . . Today, a patentee or operator . . . invests his time, effort and capital in the development and exploitation of an invention because of a monopoly grant (a patent) by the Government, only to have the courts take away the monopoly when the patent is put to test. . . . The patentee feels he has been cheated. He does not understand the Government patent-issuing and patent-adjudicating machinery, for he is not a patent lawyer."

Patents have never been accorded the "security" that our Constitution contemplated. We have policemen, sheriffs, prosecuting attorneys, and prisons to guard other classes of property from thieves and marauders. In the United States, it has always been that anybody could encroach on the other fellow's scientific property; could infringe a patent. There has never been a penalty for infringing, and the patent owners could stop infringement only by litigation. *Fortune* (August, 1942) says:

"The most versatile of all devices . . . is the infringement suit, one of the most expensive forms of litigation. . . . More time, money and energy have sometimes gone into this kind of warfare than ever went into the original technological development."

This is certainly a disgrace to our patent system. In recent decades, the pendulum has swung so far to the favor of the infringer and to the hazard of the patent owner that the Davids have been driven practically off the scene, and Goliath holds about all of the development field with impunity.

To quote Judge Frank further:[1]

"The picture has completely changed. In the last few decades, the single inventor, toiling against odds, has, for the most part, been replaced by the research group, busy in the shining, well-equipped laboratory. Even Patent Commissioner Conway Coe, an ardent defender of patents, testified in 1936, 'I do not say that the day of the individual inventor is gone, but I think it is rapidly fading.'

"An advisory committee of leading researchers, including several who are successful inventors—among them F. B. Jewett, head of the great Bell Telephone Laboratories—impressively reported in 1935: 'There has been enormous change in technique and commercial practice in the last hundred years. The patent system at its inception contemplated an individual inventor given a monopoly for seventeen years as a reward and stimulant for invention, and to enable funds to be obtained for commercialization. That simple situation no longer obtains. What was originally a self-sufficient patent to an individual inventor for seventeen years has developed into a patent structure or assemblage of patents, giving a substantial permanent monopoly in an advancing art to an industry or group of industries'."

Taking patent protection away from individuals and small business automatically puts them off the scene, and puts inventions and patents into the hands of the big corporations. It must be so. It could not be otherwise. It is nothing against the corporations that they are big. And if, then, they profit from their advantage, can they be blamed? Note, it is no inherent fault of the patent principle that gives them practically the whole field. It is putting risks and costs onto patents that only the big fellows can sustain. Then our press, our Congress, and our Department of Justice bewail the monopolies and seek to knock them out. Having knocked out the small development man, shall we now proceed to knock out the big one?

Giving development over to the Goliaths with their laboratories and equipment does not for the most part promote science and the useful arts. The biggest single factor in competition is a good product. As one philosopher put it with somewhat more force than elegance, "It's no trick to be a salesman when you have something to sell that folks want to buy. When you have something to sell that folks don't want to buy, then it's a h--l of a trick to be a salesman." The Goliaths may hold monopoly on large capital and equipment, but they have not a monopoly on the brains and never have had. Printing men did not invent the linotype. Oil companies did not invent the electric light. Telegraph companies did not invent the telephone. Railroads did not invent the air brake. Mr. Frank B. Jewett, previously mentioned, is authority for the statement that of three big telephone improvements, two of them came from outside the Bell Laboratories.

"SECURE" PATENTS FOR THE OWNER

It is remarkable that with all the agitation about patents, no one suggests upholding the small man, and no one suggests enforcing the Federal Constitution. Let us try it. Give everybody ample opportunity to contest a patent application, and then issue a patent incontestable and irrevocable for its term of years, and "secure" the owners with police and prosecuting attorneys and prisons, the same as we now protect other property. Then will the Goliaths, the Davids, and all hands produce for public consumption and benefit, pulling together as we did in the war.

The public has the same interest in patents that it has in pigs; and it has a vital interest in pigs, as it requires some millions of pigs each year for its food supply. It gets them by securing the farmer, by protecting his pigs from theft until it shall pay him a fair price and a fair profit for them. We have recently tried taking the profit out of pigs, and only too well do we know the result: no pigs on the market and no pork on our tables. Now we have abandoned the experiment, let us hope for all time.

We have tried taking the profit out of patents. We have driven the small inventor pretty much off the scene, and have undoubtedly driven a large mass of development and industry and employment off the scene with him. Let us relegate to oblivion the experiment on profitless patents along with the experiment on profitless pigs; let us put a patent on at least as high a legal plane as a pig and give it simple and absolute protection, a brand of justice that it won't take a patent lawyer to understand.

But, we are told, a firm can take out a multitude of patents and "come to be as it were the lord of an industry;" that the public must pay tribute to such a monopoly; and that by patenting improvements from time to time such firm can extend its monopoly far beyond the statutory 17 years. They tell us that "the public has a big stake in patents," that their "influence extends into every phase of modern enterprise," that they hold up prices and restrict trade. The public and our public press resent this influence. Our Government, claiming to represent the public, has narrowed the rights of the patentee through legislation; and through its Department of Justice, it attacks patent monopolies with antitrust suits.

IS THE INVENTOR ENTITLED TO HIS REWARD?

Let us see. Suppose that John Q. David patents a spring wheel for automobiles; that he secures resilience through metal springs, that he eliminates pneumatic tires with their flats and punctures, and that his wheel proves superior and comes into general use. Suppose he takes out scores of patents on various

[2] "The Patent Situation and Society," by E. R. Posnack, MECHANICAL ENGINEERING, vol. 68, 1946, pp. 720–722.

arrangements of springs and wheels, and covers the field so completely that John Q. Public cannot make spring wheels without infringing. Suppose that David patents improvements from time to time and extends his monopoly beyond the 17 years. He holds up prices and controls the spring-wheel industry.

1 John Q. David is not imposing on John Q. Public; is not taking anything away from him. John Q. Public does not have to buy spring wheels. He got along without them until John Q. David came along. He can continue to get along without them, and he will get along without them unless they are worth the price. If they are worth the price, he will buy them of his own free will and to his own advantage.

If the spring wheel shall have gone through the same process of evolution as the locomotive or the automobile or the airplane or most other inventions, the patent on the early spring wheels would be worthless. The early locomotive patent was on one that men and boys could keep up with, and that a stagecoach could outrun. The early auto patent was on one that ran 7 miles per hour. The early airplane patent was on one that could stay up 59 seconds and fly 852 feet. Only after the improvements of years, have most inventions become valuable, and to deprive patentees and developers of protection on their perfected products would be confiscation unwarranted and preposterous.

2 John Q. David must yield his monopoly when John Q. Public is in great need, as in war or emergency. A great deal of printers' ink has been wasted about patents curtailing production in time of war. The National Patent Planning Commission put that question effectively to rest; they said:

"Existing laws permit the Government of the United States and its contractors and subcontractors to manufacture and use any invention, patented or unpatented . . . upon payment of reasonable compensation. These laws operate both in peace and in war. After consulting with the several Government departments, including the War and the Navy . . . the Commission is convinced that the existing laws are adequate to protect the Government during the present national crisis. . . . Specific inquiries addressed particularly to representatives of the War and the Navy Departments failed to develop any serious instances in which the patent system has interfered with the prosecution of the present war." (House Document No. 239, June 18, 1943.)

Every patent can be issued with that reservation printed into it, and it will be well to have it so, though it would not give the public any more rights to seizure than it has now.

3 In the United States, John Q. Public, eliminating children and incompetents, comprises a hundred millions of people, more or less. Every one of them was privileged, or should have been privileged, to invent and patent a spring wheel. For a few cents each, every one of them could have gotten copies of John Q. David's patents to guide him to improvements. Thousands of John Q. Public were servicing John Q. David wheels and knew them from the practical standpoint. If a hundred millions of John Q. Public could not and did not make the inventions and improvements, and John Q. David did make them, then John Q. David has a real right to them.

Again, suppose that $99^{44}/_{100}$ per cent of John Q. Public were frightened out by knowledge or fear that they could not hold right to their inventions. That still leaves well over half a million of John Q. Public, more people than there are in Minneapolis or Cincinnati or New Orleans, free and clear to invent and patent spring wheels. The chances are that many of them had more money and many of them more education than John Q. David. They included rich corporations with research laboratories and trained personnel. If they could not do it or did not do it, and if John Q. David by his brains, perseverance, energy, and sacrifice did do it, then he has earned his monopoly and is rightfully and morally entitled to it. John Q. Public will profit by paying him to do a job that a hundred millions of them could not do.

This all recalls a drawing teacher, who said to his class, "If a student shall spoil a drawing, shall tear it, or get oil or grease on it, it is permissible for him to hand in a photostat of it." Then he continued, "Please understand just what I mean and what I do not mean. I do not mean that one student can photostat another student's drawing, put his name on it and hand it in."

Similarly, a hundred millions or half a million of John Q. Public are entitled to their own drawings, to their own inventions, and creations. We hold that they should be protected to the limit in possession of those creations. They are not so protected now, but they can be if they rise and demand protection. They are not entitled to the creations of John Q. David, who simply took what they were entitled to take and didn't.

RETURN TO THE SPIRIT OF PROTECTION

We are not yet ready to eliminate our Davids and to turn our inventions and development over to the Goliaths of industry or to anybody else. Our Davids are the equals of any on earth. Protect them and they will deliver the goods. This is not advocating any new or doubtful experiment. It is advocating, in large part, a return to the law that was worked out in American practice through a period of 75 to 100 years. It is advocating the "security" and "monopoly" that have had the sanction of law for well over 300 years, and that our forebears built into our Federal Constitution.

We are not yet ready to eliminate that Federal Constitution. Enforce it and our Davids and their associate enterprisers will build a vast middle-class industry, in competition with the Goliaths, to be sure, but alongside them and in co-operation with them, an industry "of the people," of all the people, "by the people, and for the people" which is American free enterprise.

French Industry and Reconstruction

(*Continued from page 301*)

DOMESTIC INDUSTRY KEY TO RECONSTRUCTION

In retrospect, then, it is not difficult to appreciate why French plans for reconstruction depend heavily upon domestic industry for their success. Primarily, an unprecedented output of manufactured goods is needed to replace what the war destroyed. Then, in order to raise the national standard of living, the blessings of modern technology must be made available through industry to all the population. Finally, this industry must provide the means of obtaining international exchange by furnishing a stream of up-to-date high-quality goods which can be sold outside the country.

It seems almost impossible that all the supporting conditions necessary to create and maintain the sort of industry France needs can be produced; but the task facing the reconstructionists is at least well defined, and every engineer, economist, and political scientist can probably tell for himself how well that task is being performed from the simple following of day-by-day world happenings.

ACKNOWLEDGMENT

The author is indebted to Mr. Jacques Debre, Commissioner for Industries of Electrical Construction in France for the statistics and some of the facts used in this paper.

EMPLOYER PRACTICE *Regarding* ENGINEERING GRADUATES

Report of Preliminary Survey[1]

THE younger engineers have been actively seeking advice and guidance from the national engineering societies of which they are junior members. The Engineers' Council for Professional Development has consistently endeavored to better the professional status of the engineer, but in recent years there has been an insistent request from a small but voluble portion of the junior engineers to obtain from the societies some tangible aid regarding their economic status.

The Engineers Joint Council recognized that surveys of the engineering profession regarding salaries and advancement based upon data obtained from employees as individuals should be supplemented with a survey of employers in industry. The object of this survey is to learn directly from a representative group of industrial employers their attitudes and policies pertaining to the selection, training, placement, advancement, guidance, and professional activities of engineering-graduate employees.

Before canvassing industry on a large scale, a trial questionnaire was sent in May, 1946, to 174 employers of engineers, including small and large organizations. Replies were received from 104 employers in 19 fields of industry up to Aug. 1, 1946, and form the basis of this report. Colleges were also included, as they, too, employ the graduates of their own or other schools as well as those who return from industry to teach.

The data from the questionnaire have been studied with a view to preparing a more complete questionnaire to be sent during the fall of 1947 to a larger and more representative list of employers.

This report has been prepared in the belief that the present data may be helpful to the junior engineers, the employers of engineering graduates, the colleges from which future graduates will be available for employment, and the engineering societies.

Collectively, the 104 co-operators employ more than 2,000,000 persons, of whom about 40,000 are engineers. Because of the representative character and distribution of the co-operators, the data received from this preliminary survey are regarded as worthy of a brief analysis and report. See summary data in Table 1.

GENERAL OBSERVATIONS

The following general observations are based on the questionnaires returned:

Who Are Hired? Ninety-six per cent of the co-operators employ cadet engineers directly upon graduation from engineering schools, but only 4 per cent recruit their engineering staffs exclusively from the new graduates. About 43 per cent hire more than half of their new engineer employees after one or more years' experience with other employers. This is evidently a matter of necessity or expediency rather than preference, because more than 60 per cent of those reporting indicate that they prefer to hire the new graduate.

How Are Cadet Engineers Recruited? Seventy per cent of those replying send representatives to engineering schools, who interview students individually; nearly all of these discuss the candidates personally with members of the college faculties in addition to interviewing the students themselves. The conditions existing in the employment field prior to and to some extent at the time of this survey are evidenced by the fact that 51 per cent of the co-operators invite students to visit their plants at company expense.

Other means of recruiting new graduates are apparently of little avail. The other methods reported, in descending order of effectiveness are: voluntary applications, advertising, summer employment of students, employment agencies, and recommendation of friends.

How Are Experienced Engineers for Specific Openings Obtained? For filling specific openings, advertising is used by 50 per cent of those replying and employment agencies by 35 per cent. Thirty-five per cent also utilize the facilities of Engineering Societies Personnel Service, Inc.,[2] 18 per cent consult placement bureaus, and 12 per cent report that their present employees bring men in. A few co-operators obtain engineers from associated companies, but United States Employment Service and the National Roster of Scientific Personnel are each used by only one company in this group.

How Are Engineering Employees Selected? Twenty-five per cent of those reporting do not differentiate between engineers and other employees in the process of hiring. The other 75 per cent rely chiefly on personal interviews between the candidates and engineering executives, although 20 per cent of the co-operators employ aptitude or other tests for evaluating the applicant's ability. Only two companies report that engineers are hired without meeting at least one executive engineer.

Of those who rely on interviews with engineering executives, 35 per cent depend on the judgment of a single executive,

[1] This report was prepared by the E.J.C. Subcommittee on Survey of Employer Practice Regarding Engineering Graduates, 25–33 West 39th St., New York 18, N. Y., which consists of the following: E. G. Bailey, chairman, William N. Carey (A.S.C.E.), Francis B. Foley (A.I.M.E.), H. T. Woolson (A.S.M.E.), R. C. Muir (A.I.E.E.), Lawrence W. Bass (A.I.Ch.E.), and Wm. F. Ryan (N.S.P.E.).

The survey was made by a subcommittee of the Engineers Joint Council's Committee on the Economic Status of the Engineer. The Committee is composed of representatives appointed by American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Chemical Engineers, and the National Society of Professional Engineers.

There are two other subcommittees; one is now compiling a report of a recent survey of the engineering profession, and the other is preparing a manual on collective bargaining by engineers in professional work.

[2] Engineering Societies Personnel Service, Inc., is a corporation owned and operated by the Four Founder Societies as a special employment service in the engineering profession. It is a self-supporting corporation operated from receipts obtained through charges made to engineers who are placed in positions. The Service at present has four offices with addresses as follows: New York, 8 West 40th St.; Chicago, 211 W. Wacker Drive; Detroit, 100 Farnsworth Ave.; and San Francisco, 57 Post Street.

The four secretaries of the Founder Societies constitute the Board of Direction of the corporation and direct its operations. Summaries showing men available and positions available are carried monthly in the publications of the Founder Societies, and this information is otherwise circulated widely to many local sections and other interested engineering groups.

and less than 50 per cent indicate that the candidate is interviewed by an engineer as high in rank as division head or assistant chief engineer. On the other hand, several companies report that each candidate is interviewed by several responsible engineers, including the top-ranking engineering executive.

What Are the Bases on Which Engineering Employees Are Selected? The questionnaire listed nine items presumably considered when selecting an engineering employee, asking each co-operator to list the order of importance given to each in arriving at an over-all evaluation. From a statistical analysis of the replies, weighting the first, second, and lower choices in the way that preferential ballots are usually counted, the considerations which carry the most weight in selecting a candidate for an engineering position, in the order of their importance, are as follows:

1 Personality
2–3 { Scholastic record
Indicated promise of development in specific field of engineering }
4 Engineering experience
5 Evidence of ability to co-operate with others
6 Recommendations by qualified persons
7 Indicated promise of executive development
8 Standing of college from which candidate was graduated
9 Salary requested.

If only first choices are considered, the order of preference is somewhat changed, engineering experience ranking second instead of fourth, but personality still leads the list. Experience would no doubt rank higher and scholastic record lower, if it were not for the fact that the employment of recent graduates is uppermost in the minds of those seeking to increase their engineering forces.

Perhaps the items given in the questionnaire were not the best that might have been chosen to portray to the young engineer the qualifications most sought after by the employer. In the blank space in the questionnaire ten co-operators added "interest in assignment;" two added "interviewer's evaluation;" and three, "character."

As some of these items are the same or similar attributes in other words, the desirable traits might well be summarized as a well-rounded-out individuality with a good personality, qualified by education and experience to make a good engineer.

Is the Present College Training of Engineers Satisfactory? Eighty-three per cent voted yes, 14 per cent no. The predominant criticism of applicants for engineering employment by the 14 per cent were:

1 Lack of fundamentals—physical sciences and mathematics
2 Inarticulateness in speech and writing
3–4–5 { Lack of education in the humanities
Lack of drafting and design experience
Lack of knowledge of economics and business }
6 Lack of knowledge of operation and production.

The Compton Committee of the S.P.E.E.[3] quotes from another survey of 100 companies by the American Telephone and Telegraph Company a similar question, the returns from which were as follows:

[3] "The Outlook in the Demands for and Supply of Engineering Graduates," *Journal of Engineering Education*, vol. 31, no. 7, September, 1946. S.P.E.E. recently changed its name to American Society for Engineering Education.

WHAT IS YOUR OPINION OF THE ENGINEERING GRADUATES?

Replies:	Per cent
Excellent or very good	12
Satisfactory	38
Deficient in certain particulars	35
No opinion	15
Deficiencies reported can be grouped as follows:	
Human relations	9
Use of English	9
Accelerated-course graduates below par	7
Lack practical perspective	5
Lack training in business	2
Lack ability in design	2
Training too theoretical, needs broadening	2

What Is the Prevailing Policy in Regard to Starting Salaries and Advancement? Twenty per cent of the co-operators indicated that every new engineer employee is regarded as a special case and starting salary is based on his particular qualifications. The others were about equally divided between those who are influenced by prevailing rates in other companies and those who indicate that their salary scales are arrived at independently.

No company reports a starting monthly salary of less than $150, and only four less than $175. Five companies report starting salaries above $250. The median (50 per cent level) is approximately $207 per month.

The Compton Committee summarized data contributed by 125 companies in April, 1946. The average starting monthly salary of graduates with bachelor degrees is $210, with variations from $125 to $320.

In regard to advancement after initial employment, only 26 of the co-operators gave data. They were all within twelve industries, but none had enough data to indicate a reliably consistent trend for the individual industry, therefore they were grouped and the average rate of advancement is approximately as follows:

	Median			
Time of advancement	Minimum percentage	Percentage, Base = $207	Actual	Maximum percentage
At the end of 6 months	2.5	8.0	$16.60	14.3
At the end of 12 months	3.6	14.6	30.30	28.6
At the end of 18 months	7.5	24.2	50.00	42.9
At the end of 24 months	10.0	29.2	60.40	57.2

In lieu of or in addition to standard increases, 76 per cent of the co-operators report that periodic reviews are made to determine salary increases on a merit basis and 24 per cent are guided chiefly by recommendation of superiors. Less than 7 per cent indicate that adjustments are made to meet competition and retain capable men.

The Compton Committee report also shows starting salaries from holders of bachelor degrees in 1939, and master and doctor degrees in 1939 and 1946.

The report of the E.J.C. Subcommittee on Survey of the Engineering Profession, based upon questionnaires addressed to about 100,000 engineers, should be available in the near future and will give more comprehensive data on salaries and actual rates of increase.

What Is Done for Technical and Professional Development of Engineer Employees? Only 50 per cent of the co-operators report that special provision is made for professional development of the young engineers in their employ, but practically all indicate that their engineering organization provides definite opportunities for professional advancement.

Thirty-seven per cent have formal training programs for young engineers; 65 per cent indicate that jobs are varied to provide a broad training; 41 per cent provide technical pro-

TABLE 1 SUMMARY OF SIGNIFICANT DATA FROM SURVEY OF EMPLOYER PRACTICE REGARDING ENGINEERING GRADUATES

(Industries arranged in groups according to percentage of engineers to total employees, item 9.)

(1) Group	A	B	C	D	
(2) Industries included	Colleges	Instrument Electrical Petroleum Chemical Aircraft	Machinery Building Paper Glass Utilities Metals Coal	Textiles Soap Rubber Automotive Shipbuilding Transportation Food	Total and averages weighted by individual co-operators
(3) Questionnaires sent out	10	47	74	43	174
(4) Questionnaires returned	8	32	44	20	104
(5) Questionnaires returned, per cent	80	68	60	47	60
(6) Total employees	4,785	438,874	788,408	780,994	2,013,061
(7) Total employees of those reporting both total and engineering graduate employees	1,310	438,874	630,658	500,994	1,571,836
(8) Engineering graduate employees	585	21,252	9,333	2,588	33,758
(9) Engineer employees to total, per cent	44.6	4.85	1.48	0.52	2.15
(10) Range in per cent of engineers to total employees, when grouped by industries	44.6	6.6 to 3.9	2.0 to 1.0	0.9 to 0.3	44.6 to 0.3
(11) Starting monthly average salary, dollars	198	208	210	204	207
(12) Executives who are engineering graduates, per cent of total executives	70	41	48	23	42
(13) Officers who are engineering graduates, per cent to total officers	52	39	41	24	37
(14) Engineers' role in development of company "very important," per cent co-operators	100	90	77	65	80
(15) Engineering graduates "better potential opportunities" than other employees with comparable education, per cent co-operators	50	57	66	45	58
(16) Opportunities for future advancement of engineering graduates "greater than ever," per cent co-operators	86	57	64	42	59
(17) Estimated increase in engineering graduates needed in next 4 years, per cent of present engineers	23	32	34	26	31

grams within the company; 78 per cent encourage taking courses outside of company hours, and more than half of these contribute to the cost of tuition for such courses. (Some multiple choices are included in the foregoing percentages.)

Is Membership in Engineering Societies Encouraged? Practically all encourage membership in engineering societies. Nearly 30 per cent pay the dues of certain employees in certain societies. Traveling expenses are usually paid by employers for attendance at meetings when employees are authorized to serve on committees, prepare papers, present discussion, and the like.

SUMMARY OF SIGNIFICANT DATA

The previous statements gleaned from the returned questionnaires broadly cover the entire group of industries, without any differentiation between them. The significance and value resulting from them may apply generally to all employers of engineering graduates.

It is recognized that all industries are not equally interested and dependent upon the engineering graduate, nor are all industries equally attractive with recognized opportunities to the engineer. It is hoped that a more complete survey at some time in the near future will enable some real benefit to be derived for all concerned from a thorough analysis of individual industries. It is believed that some good along this line may be derived from this survey by grouping the industries in some manner relating to their interest in the engineering graduate. The percentage of engineers to total employees has been chosen as the basis for dividing the co-operators into four groups, A, B, C, and D, as shown in Table 1.

Item 10 gives the key to the grouping. The colleges stand alone with a high percentage of about 45 per cent engineering graduates as Group A.

Group B includes instrument 6.6, electrical 5.1, petroleum 4.9, chemical 4.2, and aircraft 3.9 per cent.

Group C includes machinery 2, building 2, paper 1.8, glass 1.5, utilities 1.4, metals 1.4, and coal and coke 1 per cent.

Group D includes textiles 0.9, soap 0.8, rubber 0.7, automotive 0.6, shipbuilding 0.6, transportation 0.5, and food 0.3 per cent.

Perhaps of some significance is the interest displayed in the return of the questionnaire itself. Item 5 shows the percentage of returns from the groups to be: A, 80 per cent; B, 68 per cent; C, 60 per cent; and D, 47 per cent; with an average of 60 per cent.

There seems to be no significant relation between starting monthly salaries in the different groups in item 11.

Engineer as Executive. The results of two questions are given in Table 1 as items 12 and 13, and are of equal interest to management and the young engineer. About 42 per cent of the executives and 37 per cent of the officers are engineering graduates.

Accomplishments of and Opportunities for Engineers. Item 14 indicates that in the opinion of the co-operators the engineer's role in the development of the company has been "very important." Group A say 100 per cent; B, 90 per cent; C, 77 per cent; and D, 65 per cent; with an average of 80 per cent. When it comes to the potential opportunities of the engineering graduate as compared with other employees with comparable educational or other preparatory background, item 15, he seems to meet with considerable competition all along the line.

As to the future, the engineering graduate is considered to have better opportunities for advancement by more than half of the co-operators in Groups A, B, and C, and only 42 per cent of those in Group D, item 16.

Need for Engineers During the Next Four Years. Item 17 of Table 1 shows that, over the next four years, an average annual increase of about 8 per cent in the number of engineers was anticipated by the co-operators when they replied in June and July, 1946, to the questionnaire reading, "Estimated number of engineers that will be employed in the near future, say, 1950." The four groups agree fairly well, with A, 23 per cent; B, 32 per cent; C, 34 per cent; and D, 26 per cent. Weighted average of all co-operators is 31 per cent of the present engineer employees.

(*Continued on page 324*)

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Monnet Plan

MENTION of the Monnet Plan in the article by Professor Luebs on pages 300 and 301 of this issue, affords an opportunity to present further comment on it from an article in *The Economist*, Dec. 14, 1946, originally entitled "Plans and Democracies." The article, reprinted by permission, follows:

To the outside observer, French politics can rarely have presented a picture of more complete deadlock than it does today. This is partly because the recent election contrived, at one and the same time, to register an electoral shift to the right and to return the communists as the strongest party. And it is partly because the parties in the middle, whose natural role it is to act as honest brokers, the Socialists and the Radicals, are both of them frightened, hurt, and resentful. A way out of the present deadlock will, of course, be found; but it can hardly be very stable or very satisfactory.

It may therefore be an irony, or it may be a lucky accident, that this is the precise moment when the French people are presented with a clear and comprehensive program of economic policy, produced by a nonparty team and capable of serving as an agreed meeting ground for all parties. The program has been produced by the "Commissariat General du Plan de Modernisation et d'Equipement," originally appointed by General de Gaulle. Its presiding genius has been M. Jean Monnet who is very well known to official London. M. Monnet has the very French gift of reducing the most complex problems to lucid simplicity, and his report gives ample evidence of this quality. Whatever criticisms may be made of its details or of its prospects of execution, the Monnet Plan remains a very impressive document. It is the first time that a democratic state has even given itself a set of authoritative signposts to guide its economic policy making. Several times, in the course of the exposition, Britain is held up to the French reader as an example to be copied. But the British reader will find himself wishing that his country had as comprehensive a guide to follow over the next few years.

The Monnet Plan is not a Four-Year Plan on the Soviet method. It does not pretend to lay down a complete and detailed plan for the whole French economy. On the contrary, it deals in detail only with six basic economic activities, the six "key resources" which govern the rest of the economy. These six are coal, power, steel, building materials, agricultural machinery, and transport. Some other industries are touched upon; but the main concern of the Plan is to sketch out programs of development for these six and to convince itself that the materials, the labor, the finance, and the other resources will be available in sufficient volume to carry them out. The world has become familiar with the concept of an economy partly nationalized and partly free. The Monnet Plan introduces the similar but much more realistic and fruitful concept of a planned sector and an unplanned sector. If the key resources are provided, if the important bottlenecks are widened, the whole economy can go forward without needing to be planned or controlled in detail. There are lessons to be learned also from the method by which the Plan has been drawn up. Eighteen "Modernization Commissions" were set up for different industries, each of them, like the British Working Parties, having employers, employees, and independent members. But, unlike the Working Parties, they were not sent out one by one without compass bearings or instructions. They were given a definite part to play in forming a consistent policy to embrace all of them. The parts consequently fit together into a whole, and M. Monnet has an industrial policy where Sir Stafford Cripps will have, at best, only a collection of unrelated expedients.

It is not, however, by its method or its philosophy but by its results, not by its details but by its entirety, that the Monnet Plan will be judged—and there the sympathetic observer cannot but feel some doubts. With admirable lucidity, the Plan throws up the fundamental question that all plans must inevitably raise if they are proposed for application in a free democratic state. Basically, the substance of the Plan is a proposal, first, to increase the rate at which the French economy equips itself with new capital; second, to direct this enlarged flow of capital expenditure toward the industries where it is most needed; and third, to provide the resources needed for this capital expansion by setting limits on consumption. This is the nature of all plans; they are all (and the Russian plans most of all) capitalist in the strict sense that they seek a rapid increase in total national output by means of an intensive application of new capital and although their ultimate object may be an increase in the standard of living of the people, their immediate method is to restrict or reduce the level of consumption.

But this, for democratic planners, is where the dilemma enters in. If, in the effort to achieve a really rapid increase in total output, a gigantic program of capital expenditure is drawn up, the sovereign people will have to consume less of its output than it would freely choose to do. But if the program of capital expenditure is scaled down to the volume of savings that the public freely chooses to make available, it will not be large enough to produce results that will look at all impressive. The Soviet State can solve all these difficulties—but because it is a dictatorship and a police state, not by any virtue of Communist doctrine. It is the power to compel the Russian people to do what they would not choose to do that makes Soviet planning work.

The Monnet Plan has not succeeded in solving this dilemma. The program of gross investment—in new capital and the maintenance of old capital combined—is set at 3000 billion francs in four years. Translated into pounds at the official rate of exchange, this would be about £1500 million a year; translated at a rate of exchange more exactly reflecting the real value of the two currencies, it would probably be less. This is not a very great deal on which to build a program of rapid modernization. The gross investment of the British community in 1938, if revalued at today's prices, would work out at something like £1200 million, and it is agreed that the figure was

too low to enable Britain to keep up in the race for industrial efficiency. But France has to catch up, not to keep up. Moreover, by no means all of the 3000 billion francs can go to productive uses. Over one fifth of it is to go for the replacement of destroyed dwelling houses, and there is an ominous footnote that no allowance has been made for military capital expenditure. The planners are therefore not to be blamed if the results they can promise for this capital expenditure remain somewhat modest. But when the medal is turned to its other side, and the program of capital expenditure is compared with the national income, of which it will take from 23 to 25 per cent, it no longer looks small, but very large. To save a quarter of its income is a lot to expect from a free community in peacetime. To use prewar Britain once again as a measuring rod, gross capital expenditure in the United Kingdom in 1938 amounted to some 14 per cent of gross national income. When all allowances are made for the rough nature of all these comparisons, it must still be concluded that M. Monnet is asking a very great effort of the French people.

The initial reception of the Plan has been encouraging. One achievement of capital importance has been to persuade the trade unions, now dominated by the Communists, to accept it in principle, even though one of its cardinal points is a return to the 48-hour week. The logic of the case for such a return is quite irrefutable—indeed, one of the most striking things about the statistics presented in the Report is how clearly they reveal the industrial stagnation of the thirties, when M. Blum was reducing hours to 40—but it is none the less surprising (as contemporary British experience will witness) to find the unions appreciating logic in such a matter. But if the Plan is to be carried out in its entirety, it requires of the French people sacrifices much harder than resolutions passed at congresses. In several places, for example, the Report hints at the necessity for postponing any plans for a large army. Will the hint be taken? One of the conditions of the Plan is that consumption should be kept within the stipulated limits. Will the black market be suppressed? It is a sine qua non that the budget should be balanced and the currency kept in equilibrium. But will an uneasy coalition be able to tackle such thorny problems as the taxation of the peasants and the suppression of tax evasion? There are to be strict priorities for capital expenditure. But will there be no politics in their enforcement? A very large man-power operation is envisaged, involving the transfer of 400,000 workers from the distributive trades (which are as swollen in France as they are shrunken in England) to productive industry. But can this be achieved without a sharp rise in wages? However sympathetic he may be, the foreign observer cannot help doubting whether there is, in France, sufficient confidence in the state to carry out so difficult a program.

Could any other democracy do better? Could Britain? As a matter of economic possibilities, the answer lies in the achievements of the war years. In 1943 the British people devoted to consumption and to civil government expenditure combined only some 55 per cent of their total output. If they were willing to make as great a productive effort and as great a sacrifice of immediate welfare for the sake of a rapid increase in their power to produce, they could devote to capital creation a volume of resources that would work miracles in a very short time. With £5000 millions a year, it would be possible to have a magnificent Plan. The problem is therefore a political one—how far will a sovereign people, in peacetime, allow its rulers to impose upon it more effort and less consumption than it would choose, on its own initiative, as a collection of individuals? It would be wrong to say that nothing can be done. It is within the power even of a parliamentary state to stimulate some increase in the community's rate of saving, by savings movements, by budget surpluses, by offering tax concessions to corporate savers and the like. It is equally within its power, by a system of licenses and controls, to exercise a very considerable influence over the objects to which the total available volume of savings is devoted.

But it is as well to recognize that there are limits to the amount of planning that a democratic government can do. Some of the limits are set by the fact that such a government finds it much more difficult to compel people to do what it wants them to do than to prohibit them from doing other things. It is also an absolute condition that the state must retain the confidence of its citizens and be able to secure the execution of its plans without tax evasion or black marketeering—which, in its turn, imposes limits on what it can ask the citizen to do. In short, the democratic planner, like the physician, must accept the basic anatomy and physiology of the patient on whom he is working, though he can do a great deal by "purposive direction" to change his features, to hasten or retard the processes of change, and to keep them in a steady state of health. There is no cause for regret in these limitations; on the contrary they are merely an illustration of the happy moderation in policy that the democratic system enjoins. But it would be just as well that the enthusiasts for planning should recognize them—and just as well also if they would recognize that the real limitations on democratic planning are not imposed by any difficulty in controlling the businessman or curbing the profit motive, but that they lie much deeper. They will not be removed by nationalization; what stands in the way of complete planning—and it is fortunate that it is so—is the ordinary man's unwillingness to let other people tell him where he shall earn his living or how he shall spend it.

Quality Control

MEASUREMENT and sampling methods to insure that only acceptable parts and components are being made during the manufacturing process rather than dependence on inspection methods to eliminate defective articles after they have been manufactured are described in a report for sale by the Office of Technical Services, Department of Commerce, Washington, 25, D. C. The report states that at Picatinny Arsenal, Dover, N. J., such "quality control" by statistical methods reduced the cost of inspecting tetryl pellets for bomb fuses by 48 per cent and saved $25,000 per month in the inspection of detonator charges.

The report "Quality Control at Picatinny Arsenal" (PB 39492) contains a history of quality control as applied at Picatinny and the appendix, "Quality Control Through Sampling Inspection" (PB 39493), contains detailed instructions for sampling inspection.

Scientific methods of sampling are particularly important in the case of ammunition because exploding tests are destructive, and if every piece is tested nothing is left. Enough samples must be tested to show how the product performs but excessive testing is wasteful, the report points out. Accordingly, tables were scientifically worked out to show the number of samples required to keep the amount of testing as small as possible and still guarantee the acceptability of the entire batch within a calculated "consumer's risk" as to the probable chances that any piece would be defective. The tables, given in the report, show the number of samples that must be inspected depending upon the size of each batch or "lot" and the number of defectives discovered.

Besides savings of material when the tests are destructive, there is a saving of man power, according to the report. Scientific sampling reduces the number of articles that must be in-

spected and thus reduces the number of inspectors required. In many cases, complete inspection of scientifically determined representative samples may be more accurate than so-called "100 per cent inspection" which may be faulty because of fatigue or inattention of the inspectors.

Quality control involves observations of the manufacturing processes and correction of any operation before defectives are made as well as scientific determination of the number of samples to select for test. Information on the various operations, prepared in the form of charts, is a most important aid in saving manufacturing costs. Measurements made at regular intervals show any trend away from the specified dimensions, and machines can thus be adjusted before they exceed tolerance limits and produce defective articles.

Control during manufacture is particularly effective when parts and subassemblies are later assembled to make the complete article. Accurate control of dimensions and properties of individual parts insures proper fitting and operation and reduces the chance of producing "duds." Moreover, when parts are made under strict quality control there is much more assurance that they will be interchangeable.

The methods used in applying quality-control techniques are described in the report and sample charts and photographs of inspection processes are also given.

Carrier-Distillation

THE utilization of uranium as a source of atomic energy requires material of the highest purity, because impurities may prevent the nuclear chain reaction through which atomic energy is released. Thirty-three impurity elements, some in concentrations as low as a few tenths part per million, have been detected and estimated through a modified spectrographic method developed at the National Bureau of Standards and used since 1942 in the Manhattan Project for analysis of uranium and its compounds. Solving a major analytical problem, the method has been applied by the National Bureau of Standards to control and inspection in the production of these materials.

Impurities differ in their effects on the nuclear chain reaction. Some elements such as boron and cadmium may interfere if present in concentrations as low as a few tenths of a part per million, and many other elements should not exceed a few parts per million. Rapid, sensitive, and accurate methods are therefore required for the determination of at least 60 chemical elements in a variety of uranium-base materials.

Early in 1941 the Bureau, at the request of the Office of Scientific Research and Development, undertook to adapt spectrographic methods to the analysis of uranium. In developing suitable methods it was evident that the interference of the spectrum of uranium, with the spectral lines characteristic of impurities, could be overcome only by separating the impurities from the uranium. This was accomplished in the carrier-distillation method by converting the uranium sample to a refractory compound having low volatility (the black oxide of uranium U_3O_8) and distilling the impurities from this compound in a direct-current electric arc.

In order to sweep out the minute quantities of impure vapors from the sample without volatilizing the uranium, a small amount of a volatile material, termed a "carrier," is added to the sample. Gallium oxide, a compound of a rare metal resembling aluminum, was found most useful as a carrier and is added at a concentration of 2 per cent in the uranium oxide. When the mixture is heated by a direct-current arc in a carbon electrode of special design, the carrier material and impurities are volatilized into the arc. The uranium, remaining as a residue, can be recovered readily from the electrode—an important consideration, particularly with some active forms of uranium.

The light of the arc, examined with a spectrograph, provides a spectrum consisting of the simple spectrum of gallium plus the spectral lines characteristic of volatile impurities in the uranium. By a proper selection of wave lengths and suitable photographic plates for the different wave-length regions, a series of spectrograms are made, from the ultraviolet region of the spectrum (2200A) to the infrared (8750A). Characteristic spectral lines, by which 33 impurity elements may be detected at very low concentrations, appear in the region covered.

For quantitative determinations, carefully prepared standards of known composition are submitted to the same treatment as the samples. Amounts of impurities are then estimated by photometric measurement, or by visual comparison of the spectrograms of samples and standards. Determinations are made to an accuracy of plus or minus 10 per cent of the amount of the element present. For example, boron and cadmium can be observed easily at a concentration of 1 part in 10 million, and

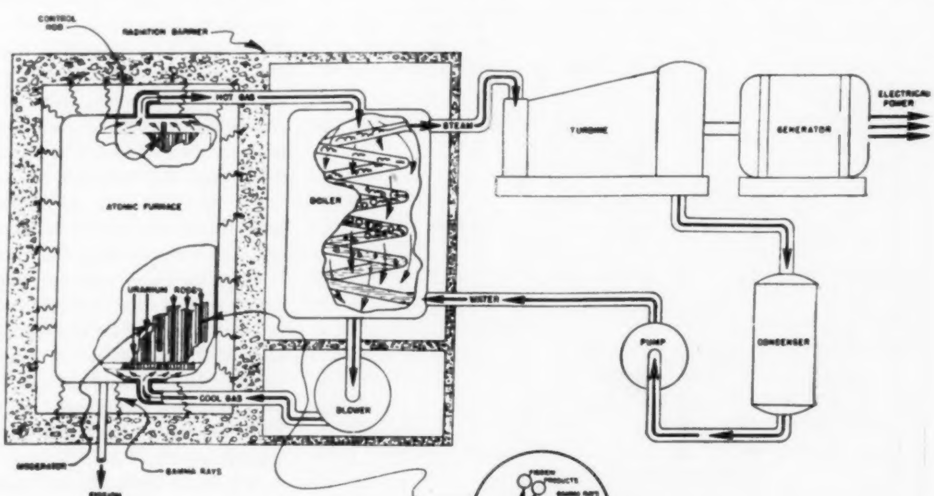


FIG. 1 PROPOSED ATOMIC POWER PLANT

(The Monsanto Chemical Company made public this diagrammatic sketch in which is indicated basic features of the projected atomic power pile at Oak Ridge, Tenn., marking man's first effort to harness the atom for constructive purposes. It is emphasized that the sketch merely outlines the broad and general principles under contemplation, and that it is not a detailed presentation.)

the concentration can be determined to within one tenth of this amount. The greatest sensitivity, observed for the detection of silver, was 1 part in 20 million.

The carrier-distillation method was applied to the analysis of thousands of samples of uranium metal, oxides, and salts. It served both the industrial producers and the Government in controlling the purity of uranium-base materials required in the atomic-energy project. Not limited, however, to uranium-base materials, it may be applied to spectrographic analysis of other materials that may be converted to a relatively non-volatile refractory form.

Weighing Machine

THE ancient principle of "positive displacement" has been utilized in the development of a new method of commercial weighing of dry products which, it is said, gives record accuracy at high speed. The new weigher, known as Hy-Tra-Lec, is described by Glen M. Tracy, research engineer, Wright's Automatic Machinery Company, Durham, N. C., in the *Sperryscope*, vol. 11, no. 1.

From the standpoint of accuracy, users report that they are securing a tolerance of approximately $^1/_{16}$ oz on packages of $^3/_4$ oz or larger.

The top speed of a single weigher is not known, but laboratory tests have been made with the weighing unit operating at 100 cycles per min. It is not practical to operate at this speed, however, because this rate gives a continuous flow of material, and it is therefore impossible to separate the charges. It has been demonstrated that the machine can operate at 60 cycles per min with a given accuracy compared with 12 cycles per min by a single beam scale providing the same given accuracy.

FIG. 2 OUTLINE DRAWING OF WEIGHING MACHINE

To date customers report that they are weigh-filling their products at speeds ranging up to 30 packages per min per weighing unit.

In every installation made to date, reports indicate that the weigher has enabled the employees to do more work, more pleasantly, and with greater ease.

The machine uses neither beam nor spring scales, the conventional basis of most automatic weighing machines. There are no weigh beams, dashpots, levers, linkages, springs, or opposing knife-edges. Nor is there a fulcrum point. Furthermore, the weigher is enclosed in a dust-free housing; accumulated foreign materials will not affect its operation.

The basic principle employed in the weigher is anything but new. Positive displacement is used in boat construction, in the float of gasoline tank gages, and hot-water heaters. Researchers have known for at least fifty years that positive displacement might offer the key to a superior method of weighing.

The basic laws of positive displacement are as follows: When a body is immersed in a liquid, whether it floats or sinks, it is buoyed up by a force equal to the weight of the bulk of the liquid displaced by the body. The weight of the floating body is equal to the weight of the bulk of liquid that it displaces. The upward pressure of buoyancy of the liquid may be regarded as existing at the center of gravity of the displaced liquid and is a force equal to the weight of the displaced liquid.

In the new weigher a number of spaced-apart cylindrical floats are mounted to a vertical bar in a tank. To the top of the bar a yoke or platform is mounted with a bucket or tray placed in position to receive the material to be weighed. The movement of the floats has been reduced to a minimum by introducing a preloading element. This movement does not take place until the last half ounce of material is placed in the bucket or tray. Weighing is done at predetermined net weights.

Spectral Recorder

AN electronic device, a spectral recorder, has been developed at Northwestern University which, it is said, will make possible a more intensive study of the stars and planets and may lead to the finding of new stars in far reaches of the Milky Way never before probed by the most powerful telescopes. It may also enable scientists to discover if there is life on Mars. Astronomers long have speculated that green spots appearing on Mars may be vegetation. It is reported that with the new recorder they will be able to record the intensity of infrared radiations emanating from the spots and to compare the intensity with that of infrared light reflected from plants on earth. If the recordings are identical they will offer the strongest evidence that the spots are living vegetation.

The recorder consists of a new photoelectric cell that translates the infrared rays into electric current and an electronic circuit that amplifies the current 10,000,000 times and records it graphically on a strip of paper. It is attached with a spectrograph to the tube of a telescope and records the invisible infrared rays given off by the stars. The infrared rays pierce through clouds of "star dust" or particles of matter in distant regions of the Milky Way that cannot be penetrated by the visible or photographic blue light of shorter wave lengths. The blue light of remote stars is diffused or "scattered" by these clouds into a fog-like haze.

When the light of a star passes through the telescope into the spectrograph and spectral recorder, it is interrupted 1080 times per sec by a motor-driven, rotating toothed wheel. The "chopped-up" light fragments pass through a chain of glass prisms in which they are separated or "spread" into a spectrum.

The infrared rays of the spectrum are picked up by the photoelectric cell and translated into electric current of about one ten millionth of a volt which varies slightly in proportion to the intensity of the infrared rays. The current then is amplified by the electronic circuit and recorded in ink on a paper graph.

The recorder also is expected to provide new information about the atmosphere of the planets—offering further clues as to whether they are supporting life—and about the stars' inner mechanism that can produce such tremendous energy indefinitely without apparent diminution.

Flying Boat

DETAILS have recently been issued of the Saunders-Roe SR-45 flying boat which is now under construction in the Isle of Wight, England. This 100-passenger aircraft is reported to have been designed to meet the requirements of the most exacting routes in the world. It will have the range and speed required for a direct London to New York service against a continuous head wind of 60 mph and will also be suitable for long-range and medium-range services in any part of the world.

The SR-45 will be powered by six gas-turbine engines of 5000 hp each, driving contrarotating propellers, giving a range of 5000 miles in still air and a cruising speed of more than 300 mph. The engines are mounted in a normal position forward of the main spar in self-contained units providing facilities for rapid replacement.

Passengers and pay load will be accommodated on this 120-ton flying boat on two decks, which will both be fully pressurized and air conditioned.

The wing floats are of a patented design with provision for complete retraction into the wing section. Also, the aircraft will be fitted with an automatic mooring device for the flying-boat dock. This automatic mooring scheme comprises an automatic pickup hook located on the keel of the flying boat below the water line, and a mooring cable running from a pontoon or dock to an outer buoy or dolphin, the cable being wound in or out by means of a winch on the pontoon or dock. This method simplifies the handling of the flying boat and reduces the time between touchdown and tie-up to as little as five minutes.

Electroplating

A NEW electroplating process in which, it is claimed, finishing costs are reduced 20 per cent or more while the resulting product has better quality and a finish fully equal to that produced by older methods, was described by George W. Jernstedt, manager of Electroplating Projects, Westinghouse Electric Corporation, at a recent meeting of the American Electroplaters Society in Pittsburgh, Pa.

In the new plating process, current is reversed periodically to remove surplus or unsound metal, level peaks, and polish. Loose or surplus plate is "wiped" off by these electrical reversals leaving only smooth tightly fastened atoms. Successive layers of plate can be built up by this method to almost any desired thickness to make a deposit more dense and of greater homogeneity than that possible with conventional continuous-current methods.

Using the periodic reverse-current method, it is possible to produce a plate that is considerably smoother than the surface of the material to which it is applied. For example, a film of copper only 0.0015 in. thick has been plated on shot-blasted steel with no evidence of the rough base metal being apparent at the surface of the copper plate. It is reported that burned electrodeposits, modules, exaggerated build-up of metal at

FIG. 3 THREE METER MAGNETS PLATED ELECTRICALLY BY DIFFERENT METHODS IN THE SAME SOLUTION AND NONE HAS BEEN POLISHED

(All received approximately the same amount of copper plate. The magnet (*left*) was direct-current rack-plated for 5 hrs; (*center*) direct-current barrel-plated for 7 hr; (*right*) periodic reverse-current-plated for 4 hr.)

corners or at sharp points—all common in other plating methods—can be reduced or eliminated when the new process is used.

Greater speed is obtained in the periodic reverse-current method of plating mainly because stronger current can be used in the plating portion of the cycle. Since the metal surface is brightened by the current reversal, hand buffing or polishing can be cut down or eliminated entirely in many cases.

The new process works better with some electrolytes than with others. Plating baths best suited for its use are the cyanide-type baths such as copper, silver, zinc, cadmium, and even gold. In general, definite and substantial improvement is evident with the new method in most acid and alkaline electrolytes. It is emphasized, however, that such factors as temperature, metal concentration, and alkalinity or acidity of the solution must be carefully studied to obtain the best results for each adaptation.

New Tooling Plastic

AN article in the February, 1947, issue of *The Tool Engineer*, by Thomas A. Dickinson, describes a new tooling plastic known as Plasticarve which was developed by P. B. Crouse and is in production at Plasticarve Corporation, Pasadena, Calif. The new material is described as a blend of thermoplastic resins and fillers. It should be particularly suitable for the fabrication of models, mockups, or patterns because it can be handformed like water clay when it is heated to only 110 F.

In its natural form, and at temperatures of less than 100 F, it is a rather brittle milk-white material with glossy-translucent surfaces and good dimensional stability. When heated to a temperature of 110 F, it retains its natural appearance although it is pliable enough to be molded with finger pressure. It melts, and has a viscosity similar to that of water at a temperature of only 150 F, but—surprisingly enough—it will undergo no further changes until it reaches its flash point of about 800 F. Most thermoplastics tend to "burn up" when heated as much as 100 deg over their respective melting points.

In its molten state, the new material can be pigmented with virtually any powdered-paint color and may be cast without parting agents in almost any type of mold, such as wood, metal, plaster, latex, plastic, and elastomer molds. The elastomer

molds referred to are molds with rubberlike flexibility, such as the Nuplamold and Plastiflex varieties which are made by combining large quantities of plasticizer with the Goodrich Geon 101 polyvinyl thermoplastic.

If it is well stirred prior to casting, Plasticarve has no tendency to form air bubbles and will almost immediately attain good surface hardness in the mold cavity even though the entire mass may not become hard for an hour or more. Accordingly, if hollow casts are desired, it is only necessary to pour off all unhardened plastic in the center of the cast after the cast has been allowed to set for a minute or two. In any event, the time required for the plastic to cool to room temperature can be reduced to a few minutes by quenching the mold in water.

Cast forms of Plasticarve can be adequately heated for hand-forming operations in hot water.

When Plasticarve articles become damaged, they can be repaired by fusion or filling-in with a soldering iron; and, after such repairs, they have as much strength as originals and can be smoothed over with a cutting edge until no seams or patches are apparent.

The injection molding of Plasticarve can be accomplished with conventional press equipment. The new material has also proved itself to be useful as a filler material which can be economically used in place of low-melt alloys for the bending of tubing.

Research

Motion of Atoms

THE motion of atoms in metals under stress will be the subject of study at Stevens Institute of Technology, Hoboken, N. J., under a research contract with the U. S. Office of Naval Research, Dr. Harvey N. Davis, fellow A.S.M.E., president of the college, announced recently.

Dr. Edwin George Schneider, assistant to the president for research, under whose direction the study will be made, stated that the purpose of the research is to gain further understanding of the crystallization which occurs when metal parts are in vibration, as for instance in a crankshaft. This crystallization is known as "work hardening," and is one of the problems to be solved in successful operation of modern machinery at high speeds and under great stress. Radioactive tracers will be used to follow the motion of the atoms in the metal.

The work is closely related to the study of the behavior of liquids as they approach the freezing point already under way at Stevens under U. S. Navy sponsorship.

Flight Simulator

Prof. Albert G. Conrad, chairman, department of electrical engineering at Yale University, revealed that research is under way at Yale on controls for a "flight simulator" or dummy rocket for duplicating the flight characteristics of a rocket missile.

The work is being done in conjunction with the General Electric Company.

The dummy rocket is being developed to permit the ground testing of missile controls. By the use of this flight simulator the control devices of missiles can be subjected to operational tests on the ground, thus reducing the need for expensive flight tests.

The research is directed at testing the complicated control devices which keep guided missiles on their course by manipulating vanes which direct the flow of escaping jet gases from the missile in its flight.

Construction of a dummy rocket is necessary in order to reproduce the rolling and pitching of a real rocket as it responds to its control vanes in flight. The test device will permit great economies in rocket development and production, eliminating the need for expensive tests.

The research will permit observation and adjustments of the control devices during conditions corresponding to flight, and so will aid in perfecting the design of missile controls. In addition, the techniques under investigation will permit a final check on each missile before the actual launching and thus will prevent misfires.

U. S. Army

In a talk which he gave before a joint meeting of the American Physical Society and American Association of Physics Teachers at Columbia University, New York, N. Y., recently, Major General H. S. Aurand, director of research and development, War Department, revealed that the U. S. Army expects to expend in the fiscal year 1947 about 270 million dollars for research purposes.

In the fiscal year 1948 the War Department expects to spend only about 4 million dollars in research contracts with educational institutions.

He said that the President's budget asks Congress for 250 million dollars for War Department research and development in the fiscal year 1948. Of this amount about 20 million will be put into pure research contracts. The remainder will be spent for applied research and development within the War Department, for scientific and engineering pay roll, and the necessary supplies to maintain laboratories.

At present ratios, about 20 per cent of the funds for pure research will be spent with educational institutions. Almost all contracts with educational institutions are for pure research as distinguished from development.

Betatrons

Plans have been completed at the National Bureau of Standards for the erection of two betatrons, enabling scientists to extend research, measurements, and standards development into the 50- and 100-million-volt range.

Two immediate problems calling for extensive investigations are the determination of measurement techniques and the formulation of precautionary principles in the use of the betatron for cancer treatment.

The problems of protection in both the medical and industrial applications of high-voltage radiation are immeasurably greater in the multimillion-volt range than in the lower regions heretofore encountered. Heavy protective barriers and expensive over-all installations are required, but the exact protection measurements and techniques are as yet unknown. One of the aims of the Bureau study is to discover the necessary thicknesses and types of construction that will give maximum protection with lowest over-all costs. Industrial use, in particular, presents difficulties not encountered in the medical applications, and the establishment of safe working conditions for the industrial betatron use is one of the principal objectives.

The betatron is also an important tool in nuclear or atomic research. Many nuclear transformations are brought about simply by exposing materials to the powerful x-ray beam. It is planned to make a systematic study of these transformations, which constitute a phase of atomic research virtually untouched at present. (A description of a 20-million-volt betatron built by Allis-Chalmers, and recently unveiled at the Picatinny Arsenal, Dover, N. J., appears on pages 34 and 35 of the January, 1947, issue of MECHANICAL ENGINEERING.)

Geiger-Müller Counters

A new laboratory to test Geiger-Müller counters and associated electronic measuring equipment has been established in the Radioactivity Section of the National Bureau of Standards. The laboratory will test performance qualities, utility, and construction of counters now being manufactured.

The fields of science dealing with radioactive matter and isotopes have grown far beyond that of physics, to include biology, chemistry, and medicine, in addition to fast developing industrial uses.

Research uses for the counters include detection and numerical measurement of particles emitted in experiments involving nuclear radiation, transmutation, and disintegration.

Many varieties of counters have been made commercially and in research laboratories. The problem of construction involves not only stability and accuracy, but also adaptation of the basic idea to the specific purposes to which the device will be put.

The new laboratory, in its testing, will attempt to bridge the gap between the manufacturer and the user, providing for expert determination and study of efficiency, stability, uniformity, and sensitivity of counters. Aid will be rendered to purchasers, by assistance in the formulation of specifications, and to manufacturers by the accumulation of test data and by determining the type of counters necessary to various fields of scientific research.

Deterioration

More than 200 research reports on deterioration of textiles, wood, leather, metals, plastics, electrical insulation, optical instruments, and other items subject to attack by weather, bacteria, or fungi, are listed in a bibliography available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

Most of the reports are based on American wartime research. Others consist of documents acquired from the research files of I. G. Farben by American investigators in Germany, and reports of interviews with German technicians.

The reports indicate that extensive deterioration research was conducted during the war because of the necessity to protect military equipment in every part of the world. Various methods of treating materials to resist attack in any climate or condition and special treatments for specific types of exposure are described in the reports.

Cyclotron

The University of Pittsburgh's 20-million-volt cyclotron is now producing radioactive elements vital to medical research and nuclear physics. This 100-ton atom smasher, third largest in the world, will be geared with medical science's new attacks on cancer and leukemia, with research into the secrets of animal and plant growth, and with industrial research in metals, chemistry, and glass. It will also investigate still deeper into the unknown forces of the atom.

The new cyclotron consists mainly of a vacuum between the poles of a giant 100-ton electromagnet. Eighteen miles of copper ribbon, weighing 18 tons, are coiled about the two poles to receive power for energizing the magnet.

In cyclotron operation, electrically charged particles of heavy hydrogen, called deuterons, are produced inside the vacuum box where they whirl around the circular chamber,

FIG. 4 TWENTY-MILLION-VOLT CYCLOTRON

(Technician adjusts mechanism to oscillate target for ion bombardment. In duralumin chamber, shown between poles of 100-ton electromagnet, ions are whirled at a speed of 20,000 mps, crushing against the target and rendering it radioactive.)

receiving up to a 200,000 electron-volt "push" at each halfway point until they are accelerated to 20,000,000 electron-volts of energy at the periphery.

Whirling at a speed of more than 20,000 miles per sec, the ions crash against the metal target, disrupting its nuclear structure, amd rendering it radioactive. The target is then removed and used for treatments or research. The whole process is rapid. Radioactive samples are produced in a matter of minutes.

A four-foot steel-encased wall of water guards the exposed or front side of the cyclotron chamber. A door several feet thick moves on wheels like a bank-vault door. The other sides of the chamber are protected by heavy earth walls.

Considerable heat is created in the generation of the magnetic field. To dissipate this heat, a special cyclotron oil was developed by Gulf Oil Corporation research engineers. More than 450 gal of this oil, highly resistant to the direct catalytic action of such large amounts of copper, are circulated about the 18 miles of copper ribbon surrounding the magnet poles.

Safety Engineering

THE Safety Committee of The American Society of Mechanical Engineers sponsored four papers on safety at the 1946 Annual Meeting of the A.S.M.E., one of which, "Methods of Accident Control for Engineers," by H. W. Heinrich, assistant superintendent, Engineering and Inspection Division, Travelers Insurance Company, Hartford, Conn., was published in the March, 1947, issue of MECHANICAL ENGINEERING, pages 227–228.

A second paper, "The Educator's Opportunities in the Field of Accident Prevention," was presented by Walter A. Cutter, New York University, New York, N. Y., in which he advocated that safety training begin at the elementary school level and be carried on through high schools, vocational, trade, and technical schools.

At the elementary and high-school levels the educator's aim should be the safety of the whole person rather than the safety of particular activities in which the individual engages.

Careful attention should be paid to strengthening the constructive attitude toward hazards, their nature, and the efficient means of meeting them. In a total school program, shop and laboratory safety will take their rightful place as specific parts of the program which merit special attention.

Because of the importance of developing proper knowledge, skill, and attitude as related to general safety, and to industrial safety as a specific part of general safety, it is well to treat each of the vocational, trade, and technical schools as if it were an actual industrial establishment.

Every effort should be made to inculcate the attitude in the student's mind that the fundamentals of safety and safe practices do not differ between a well-operated technical school and a well-operated industry. All that will differ will be the environment and the type of operations.

The following elements in the accident-prevention program of vocational, trade, and technical schools, if the schools are to realize their unusual opportunities for conditioning safe workers, should be looked for:

1 A complete accident-prevention program should cover the entire establishment, with each separate shop, laboratory, or other activity having its safety committee.

2 A responsible director should be appointed for the whole safety program, aided by a safety council composed of the heads of all specific activities and such student representation as will be expedient.

3 Complete safe-practice rules should be made for all activities, with continuous explanation of the reasons for the rules.

4 Safety should be interwoven into all operations, accompanied by continuous explanation that safety, like efficiency, is an essential component of every operation, from the simplest to the most complex. It is extremely important that this be done, so that the student, as he progresses in knowledge and skill, will also be improving his attitude constantly.

5 All tools and equipment should be safe, housekeeping should be of the best, personal protective equipment should be provided, and light, sanitation, and hygiene should meet industrial standards.

6 A complete accident-investigation system, with adequate safety records, and accident analysis is needed.

7 Regular meetings of individual safety committees and the school safety council should be held; the council, particularly, should conduct its meetings in such a way that all parts of the safety program which should come before it will receive prompt and decisive attention.

8 Where practicable a system of "recognition" awards should be worked out for shops, laboratories, and individuals.

9 Provision should be made for regular visits of industry representatives to address the faculty and the student groups.

Frequently there are hidden reasons, physiological and psychological, for the so-called accident proneness of some persons. A physiological and psychological testing program is an indispensable adjunct to a satisfactory program of accident prevention. Careful observation and supervision of individuals must go along constantly with the testing program, while the complete accident or near-accident record of every student provides supplementary means for discovering accident propensities.

What happens in teachers' colleges is of vital importance to the whole national program of accident prevention and all of the individual parts of this program. It is necessary therefore to recommend the following:

1 All teachers' colleges should have general survey courses in accident prevention for all teachers.

2 In addition, such specific knowledge of accident prevention as may be appropriately integrated with the teaching of certain subjects should be a part of the teaching program of teachers' colleges.

3 Teachers' colleges that have departments of industrial arts should pay particular attention to proper training in accident prevention for teachers of such subjects. Such instruction should include the basic principles of industrial accident prevention.

4 All phases of accident prevention which are recommended for the schools should be included in the program of the teachers' college.

Added training for teachers in shops and laboratories is recommended. Technical processes change. New knowledge is gained of accident prevention. Industrial operations are modified and frequently simplified. Increasing facilities through university courses for teachers and instructors aid them in keeping abreast of the best present practices.

TRAINING FOR MANAGEMENT ACCIDENT CONTROL

A. W. Luce, member A.S.M.E., head of department, chairman of curriculum in mechanical engineering, Pratt Institute, Brooklyn, N. Y., presented a paper in which he asked the question, "Is There or Can There Be Engineering College Training for Management Accident Control?" Accident control, which is considered first, has two broad aspects, foresight and hindsight. It is foresight to provide a hoist where it will be needed

when doing the original engineering layout of a new job. It is hindsight to see the need for such a hoist after work has been spoiled by mishandling or a back has been injured by excessive lifting.

The quality of hindsight is greatly influenced by the records made in connection with accidents involving machines or material or men. Records and statistics are historical but can be useful. Unless first-aid injury records such as the number or location of lacerations are studied for indication of causes, they are valueless for accident control. Actual accident investigations are more valuable than injury records. The record of the investigation should show facts pointing to the underlying as well as the obvious causes and to the opportunity for elimination at the source as well as to guarding at the immediate cause.

Management should inspire and give needed discipline to insure consistent effort toward control of all types of accidents. It is not enough to approve a foreman training course on safety. The foreman wants to feel that top management is itself as concerned about safety as the trainer wants the foreman to be. He wants to see other management representatives "thinking and acting safety." It is the old principle of the effectiveness of precept.

College training for management accident control should also be by precept. In addition to the inclusion of the safety concept in all instruction, there must be evidence of the day-by-day working of management accident control throughout the engineering school. A course in safety or safety engineering will not be enough. At present there is a considerable amount of safety instruction. A few curricula include a formal course in industrial safety. Many give formal instruction in safety organization as a part of industrial-management or personnel administration courses. The intensity of instruction and inspiration, however, is as dependent upon individuals as it is the management of industry. Effectiveness is dependent upon top-management performance.

Engineering-college training for management accident control should be successful because, subconsciously at least, all engineering students aspire to management responsibilities. The student looking forward in a certain field has a vision of others working with and for him. The prevalence of this expectation to supervise is an aid to safety training. Therefore it is important to emphasize the importance of the background training for assuming and placing responsibility. The educational procedure, however, seems to have at least two inherent weaknesses. They are the "60 per cent is passing" concept, and the "excuse."

School people seem to find it necessary to think of some minimum acceptable percentage of performance. Industry is approaching this in employee merit rating. Unfortunately, all students come to some degree of belief that the minimum is the standard, and that they have made it, or exceeded it, or missed it. They think in terms of how much they have exceeded the minimum rather than how much they have missed the possible goal. This is not good training for management.

In the grade-school system, an excuse is required for all failure to meet responsibility, particularly in the matter of attendance. This has the undesirable effect of leading the pupil to assume that an excuse exonerates him from responsibility for his failure to meet his responsibility. College training should seek to eliminate this excuse idea. An excuse is only a statement of the circumstances leading to a failure to fulfill one's responsibilities.

In addition to overcoming these two weaknesses, college training can contribute to management accident control by emphasizing the importance of placing responsibility at the source of prevention of accidents. Responsibility for an accident that has occurred should be placed upon the individual in a responsible position for preventing a recurrence.

Precept in college training is important. The college plant should eliminate avoidable hazards. Students can be called upon to make periodic safety surveys. These should be followed by careful analysis and by discussion of improvements carried out because of previous surveys. Safety instructions should be handled with great care and the staff must be prepared to accept responsibility in case of an accident resulting from insufficient instruction.

Finally, there can be continuous training in safety as an integral part of the instruction in laboratories, in design courses, and particularly in discussions of production design, and in management classes. The use of standard safety codes should be a natural part of appropriate instruction.

The ingenious instructor, inspired by a safety-conscious supervisor, can do much to ingrain in the student an appreciation of the responsibility of all branches of management for accident control, and of the fact that good control follows from continuous application rather than spasmodic effort.

Thus we find an affirmative answer to the question.

262,000 Unsafe Engineers?

In a fourth paper, John V. Grimaldi, research engineer, National Conservation Bureau, Accident Prevention Division of the Association of Casualty and Surety Executives, pointed out that the engineering profession as a whole has been guilty of a misunderstanding of the character of safety and therefore in most instances performs its work unconcernedly oblivious of many of the doctrines of accident prevention, confident that it is doing no wrong. At the time of the last census there were approximately 262,000 engineers in the United States and by the time the last diploma has been handed out at the close of the graduation exercises in June, 1947, there may be another 10,000 engineers all practicing or seeking to practice their profession in this country, relatively few of whom will have acquired a sensitivity to safety, either through their work experience or training.

Knowledge of accident prevention is as important to the engineer as are his basic sciences and mathematics. The engineer is concerned with life, with cost, with time, with simplicity, and many other factors that are, at the same time, influenced by safety. It has been shown that there is a definite association between efficiency and safety; one goes with the other, and, if this were the only reason it would be a strong one for preparing the student engineer with accident-prevention fundamentals.

Recently the Center for Safety Education at New York University announced the completion of a study comparing the work efficiency and safety of a selected group of 100 industrial workers. These workers were chosen because of certain physical impairments which they possessed and they were matched in social, economic, and employment factors with 100 able-bodied workers. The efficiency of both groups was measured as well as the relative safety. It was found that the disabled exceeded the normals in production when working at comparable jobs. This was evident in rate of production as well as in weekly wages earned—a factor indicating success on a job. The normals earned $40.22 per week, the disabled $51.21. It must be remembered that the disabled and normal that were compared were working on identical jobs so that both were judged according to the same standards. The accident-frequency rate for these disabled workers also was better than for the normal, the rate being 12.98 for the disabled and 17.84 for the normal. The severity rates were approximately equal for the disabled and the normal, with the normals having only an insignificantly better severity rate. In short, the group that

had the better accident-frequency rate also had the better production record. These results are even more impressive when we recall that the better producing group was composed of physically impaired workers.

The time to impart a knowledge of accident prevention is during the engineer's formative years in school, for as the engineer is trained, so will he think when he takes his place in industry. It is probably because too many engineers and teachers of engineers have been allowed to grow professionally without exposure to the advantages of accident prevention that we have a hard-shelled resistance to safety in both the schools and industry. It is becoming generally recognized that some training in safety should be included in the engineering course. At present it is believed the training should be offered by integrating the fundamentals of safety in certain specific engineering courses, and work has even been undertaken to prepare syllabuses for aiding instructors in these courses in the integrating work.

Two constructive means for infiltrating safety into engineering-school procedure and at the same time providing additional benefits for the student come to mind. The first has to do with the crowded curriculum and long difficult courses. He must, for example, memorize dozens of formulas in the case of the basic sciences, or he must learn 30 to 40 of the standard forms in integral and differential calculus, all of which takes time even for the brightest of students. Then he must set out to learn the application of these details once he has memorized them. If the student would not be asked to memorize the general formulas or data that can be found in an accepted handbook, but instead was held responsible solely for the theory of his subjects, and if during examinations he was permitted to refer to a printed or mimeographed sheet containing the data and formulas he might need to solve his problems, a long step will have been taken to ease the plight of the student and prepare better engineers.

There would be therefore an incidental resulting freedom in time for the student which would permit him to study supplementary material on accident prevention—if he was so directed and stimulated by his teachers.

Another consideration for assisting the student to profit from his time, and learn of safety as well, can be offered. This is established on the knowledge that effective retention of information depends upon the development of many means and relationships for learning material. In addition, the most important single fact in the learning of students is that they learn when they are active and motivated. The purpose for which one learns and the nature of his activity partially determine what he learns. There is evidence that study may be meaningless and largely a waste of time unless it is conducted so as to aid the student to find answers to problems. Unless he has a problem the "answer" is apt to be meaningless.

These fundamental psychological principles can be complied with by the instructor's accepting safety as his ally and using it in his courses. He can, for example, use case studies of accidents as material for formulating genuine problems and examples concerning hazardous situations the student might meet as a professional engineer. He should attempt to explain machines, processes, and materials in terms of safety, for in that way he will associate the course subject matter with something of momentous significance to his students—their safety and the safety of others—and the course material will be more apt to be retained. In short, the use of safety information in certain courses can provide the motivation the instructor wants in order to insure learning.

The inclusion of accident-prevention material in the engineering curriculum should prove extremely valuable in preparing student engineers.

THE A.S.M.E. ON SAFETY

H. W. Gabor, chairman of the A.S.M.E. Safety Committee, reports that the committee is presently engaged in the preparation and development of a plan to integrate safety-engineering instruction in appropriate courses in engineering colleges. To date this committee has prepared the fundamentals of safety engineering to show their need and value, philosophy of accident occurrence and prevention, the various causes of accidents, remedies available, and their application.

An advisory committee of eight members representing engineering colleges and industry has been working on the preparation of a plan of integration through which these basic fundamentals may be incorporated with engineering courses. This advisory committee is in communication with engineering colleges to encourage interest.

The American Institute of Electrical Engineers, in collaboration with its student branches, has prepared a pamphlet on the subject of Accident Prevention in Electrical Engineering Study and Practice. This pamphlet has been widely distributed to students who are presently taking courses in electrical engineering.

Co-operation with the A.S.M.E. committee on the project is excellent. The interest of numerous colleges, associations, and individuals has been obtained. The committee is optimistic regarding the success of the project, but of necessity, progress must be governed to a large extent by gradual development of the material, because, virtually a virgin field in which there are no signposts is being explored. This project is in the active constructive stage.

Inexpensive Oxygen

A GERMAN method of making oxygen inexpensively for commercial uses is described by U. S. investigators in two reports (PB-368 and PB-44664) for sale by the Office of Technical Services, Department of Commerce, Washington 25, D. C. Cheap oxygen is currently a matter of great interest in the chemical industries.

The production method is based on the principle of fractional distillation of liquid air. The distilling process is similar to other distillation except that it must be carried on at extremely low temperatures. Oxygen, which amounts to about one fifth of the volume of gases contained in the air, boils at about —297 F, and nitrogen, the remaining four fifths, boils at —320 F. The difference in boiling points makes distillation possible.

Separation of oxygen and nitrogen by distillation of liquid air can be accomplished by the Linde process invented by Carl von Linde, founder of the Gesellschaft für Linde's Eismachinen at Hollriegelskreuth near Munich, Germany. The process produces oxygen of 99.7 per cent purity, but it is expensive. A modification, patented by Mathias Fraenkl and called the Linde-Fraenkl process, produces 98 per cent pure oxygen at a much lower cost than that of the Linde process. Construction and maintenance costs in the modified process also appear to be lower, according to the reports. Seventy-one plants using the Linde-Fraenkl process have been built. Seven are outside Germany but there is none in the United States, according to the investigators.

In the Linde process all the air must be compressed at extremely high pressure, while in the Linde-Fraenkl process only about five per cent of the air is liquefied under high pressure. Consequently, leaks and losses are much less with the Linde-Fraenkl process and the resulting product is much cheaper.

In the Linde-Fraenkl process about five per cent of the air is

compressed to 200 atm and then liquefied after cooling by an ammonia refrigeration plant. The remaining 95 per cent of the air, at a pressure of 4.5 atm, is cooled for liquefaction by being passed through "accumulators" filled with "pancakes" made of coiled strips of crimped aluminum chilled to low temperatures by the cold nitrogen and oxygen previously produced.

For the expensive high-purity oxygen and nitrogen of the Linde process, the air used must first be dried and purified. Such refinements are not necessary in the Linde-Fraenkl process. In the latter process, carbon-dioxide and other impurities solidify on the accumulator pancakes, and the resulting solids, removed in generating the accumulators, are picked up by the oxygen produced, thus reducing the purity of the product. However, a separator removes frozen particles of acetylene, one of the impurities that may accumulate in an oxygen plant. A recent development to minimize the acetylene danger is the use of silica gel to absorb any acetylene that may pass the separator.

New Magnetic Alloy

A NEW 35 per cent cobalt, 64 per cent iron, 1 per cent chromium alloy, said to carry more magnetism than any other alloy practical for use in motors and generators, and tough enough to withstand intense vibration, has been developed by the Westinghouse Research Laboratories. It is claimed that the new alloy, "Hiperco," will make possible compact electric motors and generators an estimated 10 per cent smaller and lighter than those of equal power now built for aircraft. This is so because the high magnetic saturation point of Hiperco will permit the design of motors with less metal for the same power, or more power from the same amount of metal.

The combination of 35 per cent cobalt with iron gives the highest magnetic saturation point of any known metallic material and the 1 per cent chromium is added to make the alloy workable.

The new alloy is the result of 20 years' research, with the final difficulty of brittleness being overcome only recently. Earlier samples of the alloy were too brittle to be of great use. A method rolling was devised which enables production of a tissue-thin metal tough enough to withstand intense vibration and yet ductile enough to be bent double without breaking.

Formerly the metal was "hot-rolled" and allowed to cool slowly, but unlike ordinary iron and steel, cobalt-iron becomes brittle when it cools in this manner. It has been found that brittleness can be avoided either by quenching the alloy in cool water or by continuous rolling while the hot metal cools.

Now, with the quenching method in use, Hiperco ingots are rolled into slabs two to three inches thick, reheated to a high temperature, and rolled again to a thickness of $^1/_{10}$ in. As the strip emerges from the last set of rolls it plunges into a trough of cooling water.

The sudden cooling makes the metal so strong and workable it can be coiled like wire, whereas formerly it could not be bent at all. The cool metal then goes through a "cold rolling" process which can further reduce its thickness to as little as $^1/_{2000}$ in. For most motor and generator applications, however, a thickness of approximately $^1/_{200}$ in. is sufficiently thin.

Even though cobalt is a high-cost material, most of which must be imported from Africa, the new metal will be of value wherever smaller and lighter motors and generators are economically important.

Mineralogists now are searching for new supplies of cobalt in the United States, Canada, and China. If they should find a sufficient supply, the new alloy might replace other metals in many types of motors and generators. Today, however, its cost limits its use to such applications as aircraft where savings in weight and size are important from an operating-cost standpoint.

Defense Measures

THE National Inventors Council announced recently that it invites scientists and engineers to submit ideas for possible defenses against such modern weapons as the rocket, the guided missile, and the atomic bomb.

Charles F. Kettering, member A.S.M.E., chairman of the Inventors Council, and vice-president of General Motors Corporation in charge of research, declared that the development of the atomic bomb has not canceled out the need for military inventions. The discoveries in controlled nuclear physics, and particularly the development of the bomb are a challenge to the imagination and to the original thinking of the inventor, and he should not close his mind to the possibility of original and valuable discoveries in this field.

The Council deplored the fact that many persons, including scientists, have discounted in advance any possibility that future invention in the field of defenses against atomic warfare is possible. The Council, recalling that a few years ago the bomb itself might have been thought impossible, suggests that defensive measures may be developed. Going underground, dispersing concentrations of population and industry, and other tactical measures are defenses of a kind, the Council said, although they may seem impractical.

The Council, composed of industry and government personnel, was established to review inventive suggestions related to national defense and to recommend to the armed forces any that appear to have possible application. During the war the Council reviewed more than 200,000 proposed military devices, and many ideas are still being received.

Standardized Cockpits

AN article in the February, 1947, issue of *The Pegasus* reveals that in 1941 the U. S. Navy embarked on a cockpit standardization program in search for a cockpit arrangement that would help prevent pilot errors. Information assembled during an exhaustive examination of cockpits and pilots crystallized the thinking of the Navy and, with the aid of the AAF and the RAF, there evolved a functional, or safety, cockpit—one that is tailored to fit the flier.

The first training plane to incorporate the new cockpit arrangement is the Fairchild Engine and Airplane Corporation's XNQ, an all-metal, two-place, low-wing primary trainer powered by a 320-hp radial engine and equipped with retractable landing gear and a controllable-pitch propeller. The position of each instrument, switch, and engine control in the airplane was chosen with the pilot, and particularly his learning patterns, in mind. The result is a trainer that is very much like the advanced aircraft the student will use as he progresses to the status of fleet combat pilot.

First move in the standardization plan was an orderly arrangement of the several radio switch boxes into a more or less compact unit convenient to the pilot's right hand. The next logical step was radio equipment designed to fit the cockpit and that led to thoughts on the design of switches and how they should be operated. Today, in the functional cockpit, the "on" or "increase" switches and controls turn to the right or are moved forward, with a few exceptions. They are generally turned to the left or moved back for "off" or "decrease."

The psychology of standardization was apparent to the mili-

FIG. 5 LEVERS SHOULD LOOK LIKE THE PART THEY ACTUATE
(Landing gear lever shaped like a wheel.)

tary planners. It was obvious that any cockpit arrangement for a primary trainer should also be the pattern followed in cockpits for advanced trainers and for combat aircraft. Such a plan would eliminate the necessity for a special pilot-orientation course for each airplane.

To achieve that objective the planners studied pilot habits in airplanes. They soon began to eliminate one by one the things that interfered with the pilot's instinctive operation of controls. The maze of handles, levers, buttons, and switches was rearranged for the pilot's convenience.

The following principles in cockpit design were formulated:

1 Each control should look like the part of the airplane it actuates. One good illustration of that principle is the landing-gear lever. In the XNQ and the Douglas AD-1, the gear lever actually is shaped like a wheel and a strut. The shape and appearance tell the pilot instantly that the lever actuates the landing gear. The handle of the flap lever on the two airplanes is shaped like a flap, thick at the front and tapering back. The pilot knows that if the little wheel lever is down, the big wheels are down. There is no mistaking its purpose or confusing it with, say, the flap control.

2 The control should be placed as nearly as possible in a position in the cockpit corresponding to the position of the part of the plane it controls. For example, the landing-gear lever is, whenever possible, directly over one wheel of the plane, and the flap lever is back in line with the wing flaps.

3 The control should move in the same direction and through the same arc as the part to be operated. That has been done with the flap control. If it is moved down 15 degrees, the flap moves down 15 degrees.

4 To turn controls on or to increase them, push them up or forward. Switches are turned clockwise for on, counterclockwise for off.

5 The pilot should be required to actuate controls only once to accomplish the desired work. In early airplanes the pilot had to crank his landing gear up and in one airplane 54 turns of a crank were required to retract the gear. Heavier gear demanded and got electrical controls. A flip of a switch does the job.

These basic patterns bring about common-sense improvements in the cockpit and make it much easier for the pilot to operate the right lever with split-second accuracy. The growing complexity of the military airplane called for such simplification.

Another noteworthy improvement that went into the XNQ is a single-control rudder-pedal adjustment. The unequal adjustment of individual rudder controls was a potential hazard in all planes. The XNQ has a single adjustment for both pedals and they can be adjusted simultaneously. No indicator is necessary with this improved rudder device—the pilot does it by feel and, more important, does it more quickly.

All electrical switches are grouped on the right side of the cockpit. Circuit-breaker switches pop out, are easy to push back in. All engine controls are grouped at the pilot's left.

The AAF, with pilot comfort and placement of instruments in mind, studied dimensions of 3000 pilots in relation to cockpits. The findings were made available to the joint committee.

Shoulder straps became standard and highly necessary equipment in fighter types, but they did restrict a pilot's movements. For one thing, he could not bend down to adjust rudder pedals. Shoulder straps also restricted the movement of the stick. To correct that situation the stick was redesigned in relation to the amount of freedom allowed by the straps.

Cockpit-design studies also included the distance between the windshield and the pilot's eyes. It was found that moving the pilot back from the windshield reduces his field of vision. The angle of the windshield also was found to be important. Studies in connection with the AD-1 disclosed that a windshield set at an angle of 35 deg to the horizontal line of vision is best. A sharper angle would be better from an aerodynamic standpoint but it would decrease light transmission.

Fluorescent lighting for instrument panels during the war eliminated much glare, darkening the cockpit to increase the pilot's night vision. Now indirect red lights are being utilized. They have this advantage: The pilot can look at a red light on his instrument panel and look into the night sky with virtually no adjustment of the pupils of his eyes.

Vast strides forward in the search for a cockpit tailored to the pilot's every need have been made since the standardization program was launched but the work has not been completed.

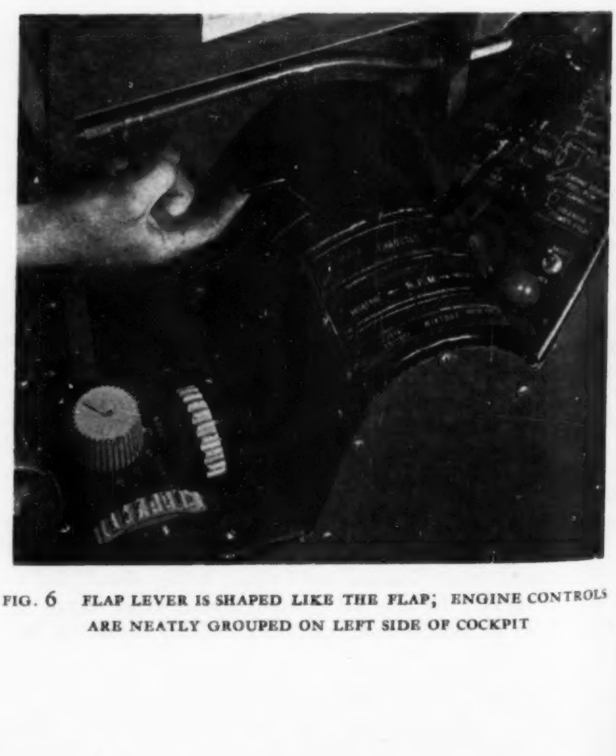


FIG. 6 FLAP LEVER IS SHAPED LIKE THE FLAP; ENGINE CONTROLS ARE NEATLY GROUPED ON LEFT SIDE OF COCKPIT

The cockpit is now less confusing and the pilot's job is a little easier, but the military men are not entirely satisfied. They want to make the cockpit still less confusing and a bit more adaptable to the pilot.

Cleaning Optical Glass

ELECTRONIC bombardment, a new method of cleaning optical glass surfaces prior to coating, was described by Collin H. Alexander, Bausch & Lomb Optical Company, Rochester, N. Y., at the winter meeting of the Optical Society of America held Feb. 21, 1947, in New York, N. Y.

The process was designed primarily for aiding application of aluminum, the reflecting agent, to television and other first-surface precision mirrors.

The ground and polished optical glass is placed in a metal holder in a high-vacuum bell, where a tungsten filament, similar to the filament in an ordinary electric-light bulb, is electrically heated to a temperature at which electrons are "boiled out." Since electrons are negative particles, they are attracted by the holder which is at high-plus voltage with respect to the filament. Thus attracted, the electrons bombard the glass at a speed of several thousand miles per second, leaving the surface entirely free of water and extraneous material.

After cleaning, the glass still contained in the high-vacuum chamber is coated with aluminum by an evaporation process. The result: A mirror of extremely high precision such as required for televising purposes.

Unlike other heating methods, electronic bombardment heats only the surface of the mirror, which almost instantaneously cools to the temperature of the remainder of the glass. The aluminum coating, applied after this treatment, will adhere.

Like most high-precision mirrors, television reflectors are coated on the front or first surface. The ordinary "looking-glass" type of mirror is coated on the back. Application of aluminum, or other reflecting agent, to the first surface eliminates an almost imperceptible but nevertheless actual dual reflection of the image.

FIG. 7 SURFACE DUST IS BLOWN FROM A TELEVISION MIRROR PRIOR TO LOWERING VACUUM BELL FOR ELECTRONIC-BOMBARDMENT CLEANING

Veneer Panel

INDUSTRIAL research to develop prefabricated houses using a new type of wood veneer made from low-grade and presently unused peeler logs is being sponsored by the Industrial Research and Development Division of the Commerce Department's Office of Technical Services.

Under the terms of a six-month "actual-cost" contract with the Elmendorf Corporation, Chicago, Ill., a private research organization, a complete model prefabricated structure incorporating the new panel will be designed, built, and tested under the specifications of the National Housing Agency.

It is said that successful completion of this project will help relieve current building-material shortages, release higher-grade lumber for other purposes, and speed emergency-housing programs.

The panel, called "K-Veneer," uses a veneer $^3/_{16}$ in. thick made from western hemlock peeler logs. In processing, the veneer is slit grainwise at $^1/_2$-in. intervals, leaving only enough fiber at the base of the incisions to hold the material together. At the same time, under tension, the veneer is expanded in area by about four per cent. The incisions provide a slack in the veneer that prevents later distortion due to absorption of moisture from the atmosphere. Depending on its intended use, the veneer is strengthened by an overlay of sheet aluminum, sheet steel, roofing felt, heavy paper, or other material attached by waterproof glue under pressure.

Marketing plans call for shipping the incised veneer in rolls to prefabricated-housing manufacturers for assembly into panels complete with interior and exterior walls and studs ready for site erection, according to procedures to be developed in the research project.

Atomic Research Center

PRESENT operations and the extent of future plans of the Brookhaven National Laboratory for peacetime atomic research, a government-owned, government-financed project operated by Associated Universities, Inc., under contract with the United States Atomic Energy Commission, now under construction on the 6000-acre site of Camp Upton, Brookhaven, Long Island, N. Y., were disclosed Feb. 28, 1947, at the laboratory's first conference. Associated Universities, Inc., is an organization formed by nine major eastern universities to erect and administrate the laboratory for the U. S. Atomic Energy Commission. It will cost approximately $50,000,000, of which $10,000,000 has been allocated thus far.

The laboratory will provide to universities, industries, and other research organizations in the Northeastern and Middle Atlantic States a training and research center for the investigation of atomic energy. It will be equipped with facilities beyond the reach of individual institutions.

Emphasis was placed on the fact that the laboratory will not be an "explosives" plant but will engage in peacetime research. Young scientists will be trained in the new fields of the atomic sciences. Also, the laboratory's work will be made available to the scientists of the country as fundamental data from which peacetime applications can be developed.

The research program of the laboratory will be directed pri-

marily to the development of new fundamental scientific information on the nature and properties of atomic energy and other applications of atomic techniques to physics, chemistry, biology, engineering, and medicine. From such research will come a better understanding of atomic energy and nuclear reactions, of methods for controlling disease and animal and vegetable life, improvement of materials and techniques for producing atomic power, and preparing radioactive isotopes, which are variant forms of an element differing only in atomic weight.

Present plans call for the construction of two atomic-energy piles and an associated "hot" laboratory, where radioactive isotopes may be separated.

Other planned facilities include a 30- to 40-million-electron-volt cyclotron; an electronuclear machine capable of accelerating either electrons or positive particles (possibly both) to energies of one billion volts; a 600- to 1000-million-electron-volt synchrocyclotron; possibly a 10- to 20-million-volt Van de Graaf (electrostatic) generator; and diverse apparatus and instruments for use in research with these machines and their products.

Radioactive substances prepared in the laboratory's two nuclear reactors (or chain-reacting atomic piles), one of low and one of high intensity, will be used primarily at Brookhaven for the research program.

The first reactor will be a graphite uranium pile which will provide research facilities during the period of experimentation and development necessary before the high-intensity machine can be constructed.

A special hot laboratory will be used for the chemical purification of radioactive substances prepared in the pile. It will be part of the first reactor program.

Research work which can be conducted with this initial reactor will include: Preparation of radioactive substances to be used as the basis for programs in chemistry, physics, biology, and medicine; study of the nature of atomic nuclei through investigation of the nature of the neutron and its interaction with matter; determination of the limitations in the industrial production of atomic power through investigation of changes produced in metals and other structural materials when placed within the pile; and exploration of medical uses of neutrons, and use of neutron beams to explore the structure of metals and other solids.

Design of a second reactor with a neutron flow and power density one hundred times greater than that of the first will begin at once.

This high-intensity pile will incorporate facilities for investigation of the fundamental engineering problems involved in power production, and in the preparation of fissionable as well as other special isotopes.

Slow changes in materials and physical phenomena, imperceptible in the first unit, will be readily observed in the second and rare isotopes, difficult to prepare, will be available in quantity. New medical techniques may result from the increased radiation intensity; and extension of knowledge of chemical relationships and the origin of naturally occurring radioactive elements will result from the preparation and study of elements heavier than any now known.

A 60-inch cyclotron which will accelerate particles to 30-million electron volts will be used for the preparation of those radioactive isotopes which cannot be produced with a nuclear reactor. These can be obtained from high-energy deuterons, protons, and helium ions, as "bullets" bombarding any other material as the target.

In addition, design research has already begun on one or more machines which will equal any now existing or in construction. Undergoing detailed study is a plan for a synchrocyclotron to produce energies of one-billion volts or more. Beams from this machine are expected to produce the mysterious meson particles in quantity, now only produced by occasional cosmic rays from outer space. Linear accelerators, synchrotrons, and other equipment to produce particles of extreme energy are under consideration.

Trustees of Associated Universities, Inc., and officers of the laboratory expect it to have a permanent scientific staff of 300,

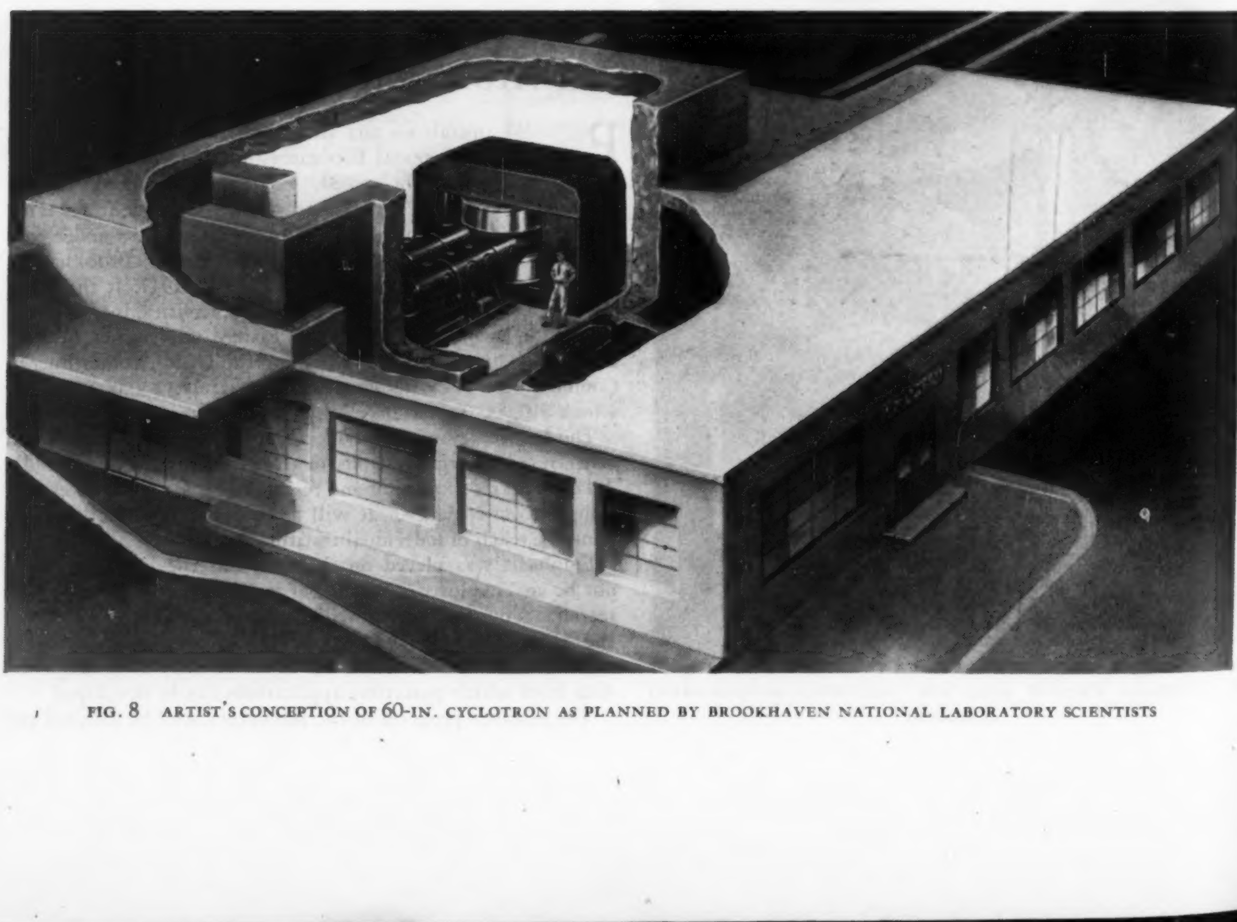


FIG. 8 ARTIST'S CONCEPTION OF 60-IN. CYCLOTRON AS PLANNED BY BROOKHAVEN NATIONAL LABORATORY SCIENTISTS

a visiting staff from co-operating institutions of 200 or more, 500 laboratory technicians, and administrative, service, and maintenance personnel numbering about 1000. Some 100 scientists will have been assigned by fall, 1947. Scientific activities, including the design of the atomic pile and other large equipment, are already under way.

The nine member universities of Associated Universities, Inc., are Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, the University of Pennsylvania, Princeton, the University of Rochester, and Yale.

Each of these universities nominates two trustees, one an administrative, and the other a scientific officer. They serve in these capacities without compensation. Associated Universities, Inc., is a nonprofit organization.

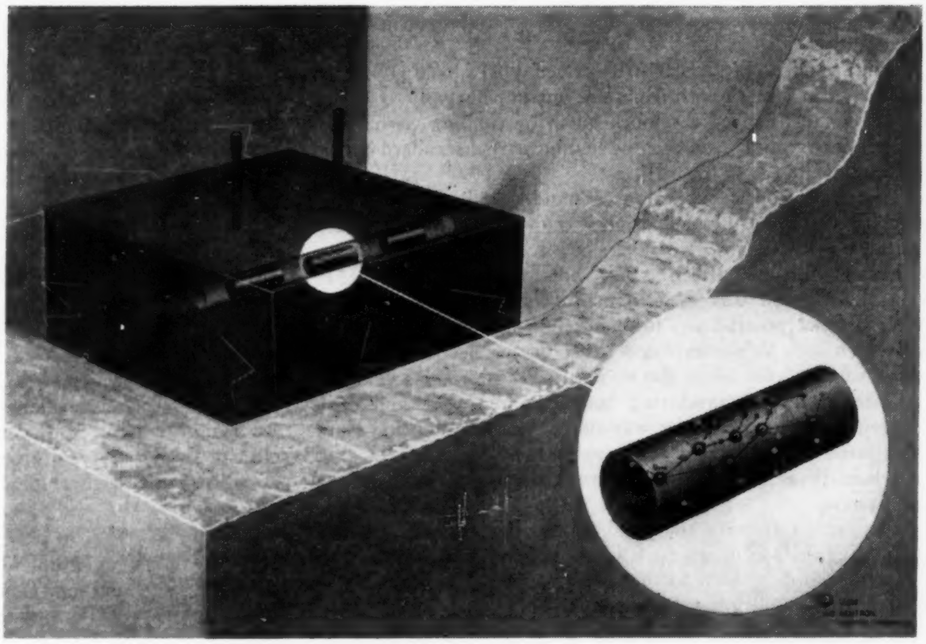


FIG. 9 DRAWING OF VISUALIZATION OF WHAT GOES ON INSIDE A GRAPHITE PILE STRUCTURE
(Insert shows chain reaction to produce power, neutrons, and radioactive isotopes.)

Other universities, as well as private and public institutions, will also participate in the research planning and the use of the research facilities.

Since the laboratory expects to concentrate on fundamental research, most of the work will be unclassified and will be available to further the progress of all science and to promote human welfare throughout the world.

Nylon

THE physical properties and potential industrial uses for molded or machined nylon are described by Louis L. Stott, The Polymer Corporation, Reading, Pa., in an article appearing in *Product Engineering*, December, 1946. Possessing unusual bearing strength, heat resistance, toughness, and chemical resistance, molded nylon is available to the designer as a useful industrial plastic.

Nylon is not a specific product, but is rather a family of chemically related high-molecular-weight "superpolymers," known as polyamides. These materials are used in many forms, such as fibers, filaments, coatings, solutions, and as molding powders in the manufacture of solid objects.

Although technically classed as thermoplastics, in that they can be injection-molded and can be ground and remolded, nylon molding powders behave in many respects like a metal. Especially noteworthy is their relatively sharp melting points, about 505 F, for the FM-1 type, and about 450 F for FM-3; the older thermoplastics, such as cellulose acetate and the acrylics, enter an indefinite "mushy" range above their softening points.

Most thermoplastics have service temperature limited to around 160 F. Nylon, especially FM-1, does not soften until temperatures well above 300 F are attained. This approximates the charring points of some thermosetting materials. Other nylon plastics, having even higher softening points are being developed.

In addition to high heat resistance, nylon offers advantages in toughness, high tensile strength, and other physical properties. Besides having low water absorption, nylon is inert to virtually all organic acids, carbon bisulphide, halogenated hydrocarbons, carbon tetrachloride, trichlorethylene, alkalies (sodium hydroxide), soaps, gasoline, benzene, aldehydes, ketones, and alcohols. The exceptions are formic and carbolic acids, these being solvents for molded nylon.

The high fluidity of melted nylon, coupled with a tendency to oxidize when molten, makes necessary close temperature control in handling, and somewhat complicates adaptation of this material to some of the usual forming techniques, such as compression or transfer molding. With minor design modifications of heating chambers and nozzles, nylon can be readily injection-molded.

Many nylon products are made by machining standard molded shapes. Made by a special process that is a combination of molding and extrusion, round rods are available in diameters from $^1/_8$ in. to 2 in. A limited range of strip and slab sizes can also be made. An efficient combination of molding and machining can be calculated by the design engineer if he consults the molder.

In machining nylon, the highest possible speeds should be used and tools kept sharp. High-speed steel or tungsten carbide should be used for best results, and tools should be ground with a large clearance angle. This will avoid rubbing which might be detrimental to the finish, as molded nylon, although dense, has a fibrous structure. There is also a tendency for the piece to push away or spring away from the tool. This is especially noticeable when turning a rod held between centers on a lathe. Even when a travel rest is used there is considerable vibration and whip. It is good practice to use a cooling fluid, hydrocarbons or soap solutions, when machining.

High-speed drills should be used, at the highest rpm possible without "gumming" the stock.

Washers, disks, and other small shapes can be machined from nylon rods either in an automatic or hand-type screw machine. Cutting speeds and feeds should be as high as possible.

For cutting screw threads on nylon rods, self-opening dies with high-speed chasers should be used. In tapping holes,

high-speed taps from 0.002 in. to 0.005 in. oversize should be used.

Nylon rods can be satisfactorily sawed with a band saw when close tolerance or smooth edges are not imperative.

Nylon can be given a smooth finish by rubbing with a fine-grade abrasive cloth and then by buffing with a standard cotton buffing wheel.

The coefficient of expansion of molded nylon in the low-temperature range is much higher than that of most metals. Therefore when close tolerances are required the dimension should be measured after the piece has cooled.

Molded nylon was used in many war applications which have definite possibilities for peacetime industrial uses, some of which are: Valve seats and seals; many electrical applications such as coil forms for miniature transformers, shaft-extension insulators, insulating bushings, and wire and cable coverings. Tests are under way on the use of nylon for gears. The use of small spur gears, involute gears, and worm gears has been investigated. Silent gears made from nylon are also of interest.

The wear resistance and good frictional properties of nylon have suggested its use in the field of bearings and investigations are now being conducted along these lines.

The latest addition to the nylon family is nylon sheeting, made of a lower melting formulation, which, because of its toughness, is expected to become a partial replacement for leather; this is only in the experimental stage.

Automatic Salesman

AN article in the February, 1947, issue of the *Industrial Bulletin* of Arthur D. Little, Inc., reveals that Americans can buy almost anything from chewing gum to railroad tickets, from grilled-hamburgers to airplane insurance, simply by inserting a coin in a machine. From the penny weighing scale automatic vending has grown in 50 years to be a $500,000,000-a-year business. In the years 1935 to 1939, sales increased 500 per cent, but still greater growth in quantities and kinds of merchandise sold is expected in the near future. Completely mechanized 5- and 10-cent stores or grocery stores, easing the load on thousands of clerks in handling small standard packages, are a possibility. An automatic grocery has already been tried out in Memphis, Tenn. There the customer inserts a special key in a slot under the display of each item she buys. The name and price of the item are automatically printed on a tape, which is later run through a translator to actuate a mechanism which drops the merchandise on a conveyer belt. The entire order, with the totaled bill, then rides the belt, at the rate of 300 articles a minute, to the cashier who may be the store's only clerk.

Merchandise for immediate consumption is best adapted to automatic distribution, but the variety of goods and services so sold is almost endless. The Automatic Canteen Company of America is the largest buyer of candy, gum, and nuts in the United States, and more than 15 per cent of all cigarettes are distributed through coin-operated machines. Refrigerated soft-drink dispensers were responsible for much of the increased acceptance of vending machines by the public; other cold foods, such as milk, ice cream, and apples, are now sold automatically. The General Electric Company and the Automatic Canteen Company of America have recently announced an electronic vending machine which will deliver a piping-hot frankfurter or grilled sandwich.

Ninety-five per cent of the coin-operated machines are manufactured in Chicago, Ill. Nonmanufacturing operators usually own and service the machines, which are placed in strategic locations, with a commission to the owner of the location.

The juke box seems to be an American institution, although it has flourished only since 1937. Five Chicago manufacturers turn out 60,000 new boxes annually, at an average cost of about $850. In good locations they usually average $25 per week and many operators own more than 100 machines. There are now about 315,000 juke boxes in operation and it is expected that this number will shortly be increased.

New refinements promise even wider use of coin-operated machines. Coin changers which collect the price of merchandise or service and return correct change will make sales that would otherwise be lost, and will accelerate the trend toward completely automatic selling. Attached to a gas pump, for instance, the device makes self-service possible after the attendant has left the gas station at night. A similar device makes possible completely automatic sales of dated railroad tickets. An increased number of personal services, such as use of an electric shaver or typewriter, foot massage, and shoe-shining are now available through automatic vendors.

A New motion picture, "This is Aluminum," released March 13, 1947, by Aluminum Company of America, shows how aluminum is made. The picture describes the steps in mining bauxite, the ore of aluminum, as well as the chemical processes involved in refining the ore before it can be reduced electrolytically to metallic aluminum. The modern prebaked carbon electrolytic cell in which aluminum is made and the latest equipment for the manufacture of some of the basic fabricated products are shown. The film is available from the Motion Picture Department, Aluminum Company of America, 801 Gulf Building, Pittsburgh 19, Pa.

Employer Practice Regarding Engineering Graduates

(*Continued from page 308*)

The Compton Committee report arrived at an estimate of 17 per cent per year. That survey was received in April, 1946, from 125 companies in industry, employing 25,556 engineers, as against this survey covering 104 companies in June and July, 1946, with 33,758 engineers among those reporting both engineer and total employees.

CONCLUSIONS

It is recognized by the Committee that the data are of limited scope and therefore should be accepted with some reservations.

The forthcoming report of the E.J.C. Committee on Survey of the Engineering Profession should be awaited with much interest by all who have responsibilities relating to the engineering graduate.

This Committee recommends to the E.J.C. that a better and more complete questionnaire be prepared and a more extensive survey be made, along the line in which this trial survey was directed, in the near future, say, the fall of 1947.

The Committee will be pleased to receive suggestions and co-operation toward the preparation of such a complete survey from anyone. Copies of the preliminary questionnaire sent out in May, 1946, the replies to which form the basis of this report, will be sent to those requesting them from the Committee. Inquiries and requests should be addressed directly to the Secretary, Engineers Joint Council, 25–33 West 39th St., New York 18, N. Y.

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Strength of Arc-Welded Joints

To the Editor:

Recently, I addressed a statement[1] to readers of this publication, among others, regarding the unnecessary handicaps now forced on the welding process. Since that time, I have become even more disturbed.

Anyone following the standards and discussion covering arc-welding electrodes and techniques cannot help but wonder. Here is a process that has been used in billions of cases for every imaginable purpose over a generation, whose record has been almost perfect, yet it is criticized and limited more than any comparable process in all mechanical history. The criticism is not because of failure, as there is none. The criticism is entirely in the region of theory covering conditions which could never occur in commercial application.

Anyone who views the situation objectively cannot help but wonder whether the people writing such standards and making such researches can possibly be serious.

There is one controlling fact regarding welded structures which, from a practical point of view, makes all of this activity nonsensical. The fact is that, in the case of mild steel, which embraces more than 95 per cent of all the welding which is done, the welded joint is very much stronger and has a very much higher elastic limit than the plates joined.

Since that is true, the weld can never be used in actual service at anywhere near its point of failure. As a matter of fact, in actual application, if the welded structure should be loaded to a point which would even approach the elastic limit of the welded joint, or the metal immediately adjacent to the weld, the structure itself would be useless.

Perhaps we can illustrate the matter this way; suppose there is a chain of 100 links, each link being made out of 1-in. round, 99 of these links being made of mild steel and one link made of high-strength alloy steel. Then suppose the chain was tested. Would anyone worry about the chain breaking in the one alloy link? He would not, because every one of the other 99 links would break long before the alloy-steel link was even partially loaded.

Exactly the same thing is true of a welded structure. The weld itself and the metal immediately adjacent to it have an elastic limit 50 per cent above that of the parent metal and have ultimate tensile strength at least 20 per cent greater. If the strength of the rest of the structure is sufficient, certainly the weld must be. As a matter of fact, structures are designed with a factor of safety so that, at its maximum load, the structure would not be up to one half of the

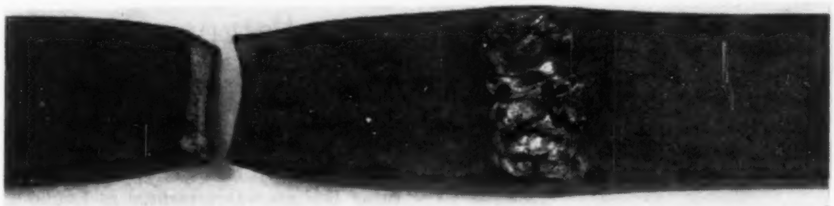


FIG. 1 TENSILE SPECIMEN CONTAINING WELDED JOINT WITH ABUNDANT SURFACE POROSITY

(The specimen failed in the plate at 59,100 psi.)

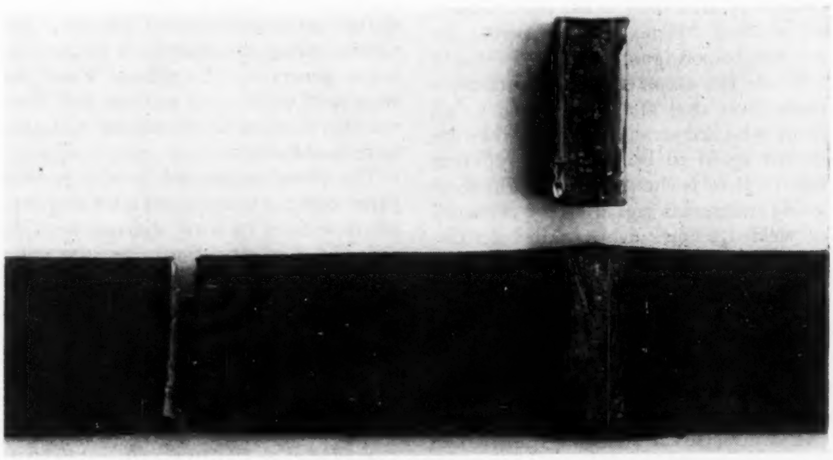


FIG. 2 TENSILE SPECIMEN CONTAINING WELDED JOINT WHICH HAS AN ABNORMALLY LARGE AMOUNT OF INTERNAL POROSITY

(Top view is nick-break view of weld immediately adjacent to tensile specimen. Tensile specimen failed in plate at 62,500 psi.)

FIG. 3 TENSILE SPECIMEN CONTAINING WELD WITH ABNORMAL AMOUNT OF UNDERCUT

(The specimen failed in plate at 59,400 psi.)

[1] Published in the November, 1946, issue of Mechanical Engineering, p. 993.

elastic limit of the parent metal. Obviously, it would not be stressed to more than one third of the elastic limit of the weld metal, and the plate immediately adjacent to it. Using our illustration, why do we worry about the alloy-steel link when the mild-steel chain is not loaded to its yield point?

Because of this program of criticism, great and unnecessary expense is put upon the manufacturer using welding. This, of course, is paid by the buyer in higher prices. No reason nor any possible return accrues to the user. There are countless illustrative cases that could be cited; the following are examples: If there is surface porosity, even so much as a little hole on the surface, the weld is rejected. If that same little hole were below the weld surface where it could not be seen, the manufacturer must cut it out carefully and reweld the joint, at great expense, after finding it with expensive x-ray equipment. Again, if there occurs slight undercutting at the edge of the weld, the weld must be rewelded, and the slight undercut eliminated.

Perhaps we could understand such rules if they were not made by engineers who obviously know the facts. However, all such rulings are made by men who insist they are expert in the profession of arc welding. Hence the conclusions are not based upon ignorance.

While the accompanying illustrations show facts that are well known to all those who are versed in the art, they are shown again to bring out the obvious facts. Here is the proof of all the foregoing statements regarding the efficiency of welded seams with so-called defects. Here is porosity carried to the greatest extreme that skill can take it, yet the joint is stronger than the plate. Here is great undercut and even laps in the weld that still break the plate in tension. Not only would such joints be rejected, but, if they had 1 per cent of these so-called defects, the structure itself would be rejected. The question naturally is asked, "Why?"

It is perfectly obvious that there could not possibly be a riveted joint which could join any of these pieces of steel together in any way which in tension would not break, yet there is no testing of the rivets, no x ray of the voids in the joint, no elimination of the undercut; yet we know in every riveted joint that all of these defects are present not only occasionally, but in every case. Again we ask the obvious question, "Why accept such defects in a riveted joint and reject them in arc welding with its greater strength, ductility, and soundness?"

Engineering has contributed to America's prosperity in an unbelievable way, but I tremble to think what would occur to our prosperity if all engineering were as remiss in its understanding of the problem as is true of many engineers' attitude toward electric welding.

There is no doubt that if the foolish restrictions, which can add nothing whatsoever to the success of any welded joint, were removed, the cost of welding those structures could be reduced by as much as 90 per cent in many cases, yet because of these restrictions, concurred in by many engineers, the industry has paid hundreds of millions of dollars in additional costs over the years with no increase in safety and no betterment of the product from any point of view.

These same restrictions still stand and are being rapidly amplified. There can be no doubt that their presence is not the result of engineering judgment. It is impossible to believe that can be true. There can be only one reason and that is a studied attempt by some people to discredit this tremendously valuable manufacturing process which contributed more to the winning of the war and to the production of a high standard of living than almost any other recent mechanical development. Such a program must be stopped.

J. F. LINCOLN.[2]

[2] President, Lincoln Electric Company, Cleveland, Ohio. Mem. A.S.M.E.

Patents Concerning Gas Turbines

COMMENT BY RICHARD HEROLD[3]

In this paper[4] attention is directed to the gas-turbine work of Sulzer Bros. Recently a paper on our turbine, among other things, was presented in England. The publication, *Power*, has also reported on it, so that development is now known. But until the paper was presented in England, our company had never mentioned its semiclosed-cycle gas turbine. We had spoken occasionally about our other gas turbine using the free-piston machine as a gas generator. Everybody knew we were working on that machine and there was little point in trying to maintain secrecy about it.

The plant mentioned in the present paper was not known, and our Company, for reasons of its own, did not want to talk about it yet. European companies take very seriously the matter of publicizing new developments and are usually shy about making any claims they haven't been able to prove by months or even years of experience.

Specifically with regard to patents, the author mentions that our first American gas-turbine patent was issued in 1941. Actually, in 1942, our first gas-turbine plant was in operation. Swiss applications, as the author stated, were filed in 1938.

He is definitely right in suggesting that a search through the patent literature, particularly foreign, would have disclosed at least our intentions. It would have disclosed something in this case, but not in all cases.

The author states that 3 or 4 years may elapse in this country between application for a patent and its granting. In other countries, just as much time may elapse. The writer recalls Dr. Keller remarking, at the 1945 Annual Meeting of this Society that Swiss patents are usually granted within 1 year. That is often the case, but just as often it is not. The Swiss enjoy a high reputation for thoroughness, but we have never been told we are particularly quick, and our patents once in a while take just as long to issue as they do over here. In 1946 Sulzer obtained several patents on gas turbines. One patent issued in this country on January 6, 1945, is based upon an application made in May, 1943. The Swiss application was made a year earlier, April, 1942, but was only issued on January 15, 1946—this took a year longer than the American patent to come out.

In the case of another patent granted in 1946, the Swiss application was filed in May, 1942, and the American in February, 1943. The Swiss patent was issued in October, 1943, within a year and a half of application, while the American patent was issued in April, 1946, over 3 years after. Therefore, general conclusions on this question cannot be drawn. Nevertheless, examination of patents is worth while and frequently revealing.

In connection with the Sulzer gas turbine, the writer would like to refer to one statement in the paper. The author describes the air heater as expensive and perhaps troublesome. Now an air heater is obviously more expensive than no air heater at all. High efficiency cannot be secured without paying for it in some way; but our air heater is comparatively inexpensive. The combustion air is drawn from the closed part of the cycle,

[3] President, Sulzer Bros. Ltd., New York, N. Y. Mem. A.S.M.E.

[4] "An Exploratory Excursion Into Gas-Turbine Patents," by E. M. Fernald, MECHANICAL ENGINEERING, vol. 68, 1946, pp. 727–732.

which is under pressure; combustion takes place under pressure too. This contrasts with the combustion chamber of the conventional closed cycle, in which burning usually take place at atmospheric pressure and it is only the air in the closed part of cycle which is compressed. The fact that in the Sulzer air heater the same pressure exists inside and outside the heat-exchanger tubes minimizes stress. This makes possible thin-walled tubes, closely spaced, and the air heater is thus small and certainly less expensive than one used in a completely closed cycle.

To us of Sulzer, patent applications are always of great interest and we follow them as closely as possible. However, we realize that complete coverage may be expensive. In the gas-turbine field, we are concerned with the turbines themselves, heat exchangers, axial and radial compressors, and many other elements which extend the field of search considerably.

The excellent survey made by the Navy, mentioned in Appendix 3 of the paper, gives a fair idea of the amount of work involved and, undoubtedly, has been very useful to everybody connected with this field. That survey covered the period from 1925 to 1942, and the writer is grateful to the author for having taken over where the Navy left off.

Author's Closure

The case histories of Swiss and American patents given by Mr. Herold in respect to dates of application and issue are most helpful. The two most recent patents show exactly opposite performance, indicating, as he said, that one can't rely on getting the Swiss patent first. Usually you do, but sometimes you don't.

Navy's patent survey of 1942 has been mentioned. It covered the period 1925 to 1942, 17 years, and aimed to list all gas-turbine patents in force in 1942. That survey is a rather peculiar product. Its preface claims that in point of coverage—actual listing—it is about 95 per cent complete. Perhaps 5 per cent of the patents were missed, but I doubt it, although no closed-cycle patents are included at all. The classification in which they appear was not covered. Navy's preface says also that with respect to indication of the bearing of listed patents on the state of the art, there is an inverse ratio of 95 per cent, the idea being that when bearing on the state of the art is considered, Navy secured about 5 per cent and missed 95 per cent. For many patents, that is true. I find Navy's patent list especially valuable because it is excellently indexed and cross-indexed. Since basic ideas are often not revealed, the information appearing needs to be verified and amplified through reading the patents. In spite of this limitation, I find the Navy list invaluable as a basis for knowing what patents have been issued, when, and to whom, and in what classifications the Patent Office is most likely to put them.

In conclusion, I would emphasize that I regard systematic reading of gas-turbine patents as a most appropriate activity for persons interested in ideas and keeping abreast, or perhaps a little ahead, of practice.

Ernest M. Fernald.[5]

Electrohydraulic Control of Diesel-Electric Drives

Comment by S. N. Hedman[6]

We are using same basic control as described in this paper[7] for governing steam turbines on paper-machine line-shaft drives. These are required to operate over adjustable speed ranges in the order of 10 to 1 with infinitely variable accurate speed control at any setting within the range. For this application the governors must be restorable to isochronous characteristics regardless of any changes in load or steam conditions for any speed setting. The exhaust steam from these turbines is used in the paper-machine driers for drying paper, and the back pressure is continuously adjusted to obtain the proper heat in the driers. In a large percentage of the paper mills using this setup, the inlet steam is taken from existing low-pressure boilers so that the energy range used in the steam turbine is relatively low. Therefore, any variation in back pressure on the turbine represents a relatively large change in the energy range available to the turbine. This change in energy range, together with the variation in load on the paper machine, represents a considerable range over which the governor must maintain isochronous characteristics if accurate control of the weight of paper is to be obtained.

We have had drives with this system of governing in operation with very satisfactory results for over a year and are applying several of them at the present time. It should also be pointed out that this type of governing lends itself very well to the various types of control required in paper-mill application; such as setting of the paper-machine speed from the head end of the machine, which in many cases is a long distance away from the turbine and governor; also, the use of preset progressive management control as encountered on parchmentizing machines in paper-processing mills. This type of control is also applicable to other types of turbine drives where appreciable speed range is required, such as encountered in textile applications.

Comment by W. M. Nichols[8]

The writer has been actively interested in this development since it was started in a rather modest way several years ago. The performance characteristics have never been difficult to achieve although there have been a great many mechanical problems which had to be solved. At the present time this governing device seems to be well proved and deserves to be classified as the forerunner of a new era in engine control.

The governor at first appears more complicated than the mechanical type; however, if the same features are applied to the mechanical type this also becomes complicated until eventually it appears that the advantages are in favor of the electrical type.

It is hoped and expected that in time the electric circuits will be simplified. Possibly the direct current can be eliminated leaving all the circuits alternating current which should help materially.

Industrial Relations

Comment by J. W. Nickerson[9]

Concerning the problem of labor relations[10] unless improvement is made, unless productivity at least keeps pace with wages, unless labor costs stop their upward ascent, then industrial profits will disappear or diminish to the point where the American people will not wish to own private industry. The result would be a collectivistic ownership of some sort which would not only reduce our overall standard of living but would destroy many of our liberties.

It is foolish to blind ourselves to the fact that the communists are making

[5] Professor of Mechanical Engineering, Lafayette College, Easton, Pa. Mem. A.S.M.E.

[6] Designing Engineer, Auxiliary Turbine Engineering Division, General Electric Company, Fitchburg, Mass. Mem. A.S.M.E.

[7] "Electrohydraulic Control of Diesel-Electric Drives," by M. A. Edwards and C. B. Lewis, Mechanical Engineering, vol. 68, 1946, pp. 953–955.

[8] Consulting Engineer, American Locomotive Company, Schenectady, N. Y. Mem. A.S.M.E.

[9] Director of Industrial Relations, Bigelow, Kent, Willard & Company, Boston, Mass. Mem. A.S.M.E.

[10] "Engineers and Industrial Relations," by C. A. Myers, Mechanical Engineering, vol. 68, 1946, pp. 1059–1060.

every effort to wipe out profits by forcing wages up and productivity down. The recent action of the stock market shows what the results may be.

What is the answer? It is productivity. More goods per man-hour to match more money per man-hour. Today few disagree with this as a generality. It is accepted that increased productivity, causing lower labor costs, will result in lower prices, greater sales volume, greater employment, higher wages, and higher standards of living. Management, labor, and Government unite on this as a general statement.

However, more than generalities and lip service are necessary. We must start the practice at the points where the opposition and misunderstanding seem to exist, at the very job itself, with the worker, with the local union.

Two things are needed: (1) ideas, and (2) co-operation in the effective use of ideas.

Engineers have demonstrated their tremendous contribution in ideas both in peacetime and in the winning of two world wars. There are vast resources of potential improvements in the methods of production. Will they be made effective in time to halt inflation and revive reasonable industrial relations? To do so, management and engineers must take such steps that the individual workers and their unions actually desire to see specific technological improvements take effect.

This undoubtedly means that, without upsetting or throwing out of balance regular methods of wage compensation, a plan needs to be evolved so that labor may promptly share in the reduction of labor cost.

With the help of engineers and with good leadership and co-operation this should be accomplished within the bounds of good industrial relations and human engineering.

Doctors or Businessmen?

EXCEPTION is taken to a plea entitled, "Better Papers Wanted," appearing in a recent issue.[11]

Statements such as the following appeared: "Few established engineers can remember advanced mathematics. It is seldom actually used in ordinary engineering work." Also, "The engineer is not primarily a scientist. He is primarily a businessman trying to make money (although usually for someone else)."

Perhaps a comparison of the engineering profession with the medical profession may help here. A person requiring a major surgical operation may go to a clever neighbor, or to a registered nurse, or pharmacist (who will probably refuse the case), or in an emergency to the head of the business office of a medical-supply house, or to a gymnasium physical director, or to a nonregistered faith healer. And, the case may, indeed, turn out successfully. It is recorded that recently a member of a submarine's crew, without regular medical training, successfully performed a major surgical operation. Most people would try to get to a regular M.D.

Likewise, a serious engineering problem presumably requires the services of an engineering Sc.D. Most of us have seen a great multitude of problems with solutions badly bungled for lack of competent doctors of engineering. The standard, minimum training for competence includes seven years of undergraduate and graduate schooling, as well as many years of assistantship practice in industry.

This is not intended to question the high character of membership in the A.S.M.E. Rather, it calls attention to the varied qualifications and characteristics of competent membership, which are so wide and broad, that any boy with a union card and three months for a Diesel school diploma is led, by imitation, to call himself an "engineer." Then, he is soon found in charge of real engineers, and receiving the corresponding remuneration. Here is a blunder, and a danger. (Genuine brainworkers often look the same as persons of substandard mental development; and the public is at a loss to tell them apart, more often being attracted to the latter.)

It has been said that "The language of engineering is mathematics." That may be only a half-truth. Nevertheless, one of the saddest sights, in the United States, is the great hoard of hopeful young students being graduated each year from hundreds of trade schools (misnamed "technical schools" and "universities") and who are completely incompetent to undertake important, fundamental, engineering problems. In addition, they are not sufficiently broadened, and educated, usually, to become our most essential types of leading citizens, inasmuch as they have not acquired the philosophy and experience of a liberal education. An outstanding few of these graduates of course really deserve the name, "engineer."

Recently, in a war industry, in one of our big companies, the writer had the experience of solving an essential problem mathematically in a mere twenty minutes of time. But the so-called "engineering management," not being soundly trained in proper principles, then wasted two to three months of time, in fiddling around with experimental tests, all to prove, finally, that mathematics was correct after all. The returned "Vets" can wonder why their war lasted so long and cost so much. Actually, this same problem was solved way back last century and is to be found in the better textbooks. When the average business management purchases proper engineering talent, they do not know what to do with it; they underpay it, in the first place; and, secondly, they place it in a very subordinate position, with no help and lots of interruptions, where it is completely ineffective. Neither do they hire much experience above age 40. Smart salesmen are preferred. No wonder the cost of living; and our national defense may be caught, sometimes, at a technical disadvantage. Some of our talent has to be imported.

All this is not intended as a criticism, either, of the high-skilled talent that exists in the shape of fine mechanics, toolmakers, inventors, semiengineering designers, slide-rule men, calculators, engineering servicemen, engineering salesmen, factory superintendents, production vice-presidents, management engineers and executives, and engineering promoters. Much of this is not engineering at all. Just what "management engineering" may mean is not here suggested: we should like to know.

Let us praise highly the skill, leadership, and usefulness to society, of great numbers of our four-year graduates and those who did not even graduate at all. Many of these, in truth, may be "engineers," since the term has something to do with a "state of mind." There is both too much and too little schooling. But perhaps now we should call for a published review of past definitions of "engineering;" and some attempts at newer definitions, in light of our startling, confusing, and rapid scientific advance.

An engineer understands physical essentials and he solves problems. Is an engineer a dreamer, a mathematician, a scientist, a mechanic, a businessman, or a combination of all these?

EASTMAN SMITH.[12]

TO THE EDITOR:

In Professor Eastman Smith's reply to my letter entitled, "Better Papers

[11] By Charles T. Chave, MECHANICAL ENGINEERING vol. 68, 1946, p. 1082.

[12] Associate Professor of Mechanical Engineering, University of Missouri, Columbia, Mo. Mem. A.S.M.E.

Wanted," he takes issue with points on which I am prepared to offer little rebuttal.

Far be it from me to suggest that the engineer is not or should not be a professional man; I am all for more training. The Diesel school diploma boys are a real menace to the engineering profession, and may I suggest that only by licensing can we overcome the dangers Professor Smith deplores.

In saying an engineer is not primarily a scientist but primarily a businessman, I meant that his job is not pure research, but the profession of using scientific knowledge plus old-fashioned technical know-how, for the economic gain of society.

Neither do I deplore advanced mathematics. We would all profit by knowing more than we do, and every large plant or office could use a twenty-minute problem solver. However, I think Professor Smith would be profoundly shocked at the results of an examination in advanced mathematics given to engineers in practice.

When a young graduate engineer takes a job, he first has to undergo hazing in the form of shop apprenticeship, operating experience, or drafting, after which he is apt to spend a few years on some form of routine design calculations which improve his slide-rule technique but not his general mathematics. If he is fortunate, he then becomes involved in management, acting more or less as a general practitioner directing others in detail work. All of this experience doesn't contribute much to mathematical ability, and management responsibility almost seems to detract from this form of knowledge. So, by the time an engineer is earning a satisfactory income, his university training is a little hazy and his theoretical technical prowess a little rusty.

Fortunately, Old Man Experience has filled the vacuum and the old rusty general practitioner has simplified his thinking, has a feel for the right things, knows a lot of generalities about all kinds of machinery and can smell a rat a mile away. He can pick bugs out of designs faster than the young graduate can hatch them, he can at last, do arithmetic, and can speak and write English. (If universities taught these subjects, he might have progressed faster.)

In comparing an engineer with a doctor, the suggestion is implied that, due to his training, the doctor will know the answer right off. I doubt it, but not knowing what doctors think (they never tell me), I prefer to compare engineers with lawyers. The field of technical knowledge today is so vast that it is beginning to resemble the law. Like a lawyer, an engineer cannot possibly hope to know all the answers. Armed with a maximum of knowledge of physical laws and effects, he is still at a loss to know the myriad of special details and techniques. He has to know where to look them up and to be able to cram up on the subject when it falls in his lap to do work in a new field.

Here is where properly presented technical articles help the poor, busy, neurotic, persecuted, frantic engineer of today. When he is striving to find out in a few hours how to build a detergent factory or why a boiler exploded in Yucatan, he should be allowed to get at least to the twenty-yard line before he is tackled by triple integrals. It takes time to get out the college calculus and take a refresher course in the middle of a busy evening. Yes, I said evening. In the daytime he answers the 'phone, reads letters, dictates replies, and signs drawings. How mathematics must flourish in the cloisters!

So, being on the wrong side of forty, I was grinding my own axe a little in suggesting that A.S.M.E. papers should present the qualitative side first, so I could get the general idea in fifteen minutes of reading; and present the mathematical analysis last, so I could say to myself, "Someday I'll go into that thoroughly," fully knowing the day will never come.

Charles T. Chave.[13]

[13] Mem. A.S.M.E.

The Patent Situation and the Society

To the Editor:

Anything having to do with patents is of vital importance in some form or other to the engineer, researcher, and scientist. Their future is indissolvably tied to patents.

From the discussion occasioned by the article "The Patent Situation and Society," by E. R. Posnack in the August issue of Mechanical Engineering, it was felt that others might be interested in the thoughts developed in a local discussion group. E. A. Andrus, a patent attorney of this city, and I briefly present herein some ideas for the consideration of fellow members.

Under our economic system the old is always competing with the new, and the new is evaluated by the public's desire for it in preference to the old. Patentees cannot charge for their new products more than they are worth over and above the old products which the public would otherwise buy. An invention, whether patented or not, that cannot measure up to this requirement of public desire has no economic standing.

While advertising and various types of production controls may limit or alter the public's choice, such practices do not relate to the patent grant.

Mr. Posnack states: "The gist of the system's evils resides in the legal right of patent owners (1) to limit production, or the field of use, of a patented commodity or process, (2) to arbitrarily set high prices on a manufactured article so that resale and consumer prices must necessarily be high, and (3) to refuse to exploit an invention, that is, to suppress it."

He then suggests laws prohibiting agreements setting a ceiling on production or a floor on prices, and providing for compulsory licensing after a few years of grace.

If we were to accept his proposal we would ignore perhaps the most vital and desirable principle of our patent system. While those favoring compulsory licensing do so upon the theory that we must have competition in production and sales, they ignore the fact that the exclusive grant in our patent system is a means of and incentive for compelling desirable competition in inventing. This principle has distinguished our system from those of other countries for over one hundred years.

In this country the great inventive stimulus under the patent system has been due largely to this exclusive grant and the healthy competition it fosters. Those favoring compulsory licenses would destroy competition between inventors and organizations of inventors, and would reduce our patent system to one functioning upon a mere money reward, similar to the Russian system.

Analysis of the three evils referred to by Mr. Posnack shows that unless the old unpatented product is taken off the market so that the public has no choice, there is nothing injurious in any of the practices outlined. If the patent owner limits production or charges too much or refuses to produce at all, the public still can use what existed before.

The fact that his patent has been issued and is available to the public will stimulate other inventors to find other solutions to the problem if there is an actual public demand or need for the product.

Under such circumstances the mere fact that a patent owner follows practices which in his judgment will net him the most from a given invention is but the working of our competitive system in the ultimate evaluation of the contribution.

To destroy this right is to curtail the market for inventions and substitute a lower standard of evaluation, one which substantially reduces the individual inventor's chance of adequate pay and which will reflect in lower salaries for engineers and research men.

Mr. Posnack states that the Government should have the right to initiate a lawsuit to test the validity of a patent and to intervene in pending patent litigation.

How much better it would be if the Government, on behalf of the people, would strengthen the patent office and correct any error at its source, rather than to induce a patentee to think that he has protection and then subject him to the expense of a suit against him on a patent which he may not be asserting. Which part of the Government would be acting in the public's interest, that which is carrying out the constitutional mandate to promote the progress of science and useful arts, or that which would destroy the former?

There is no justice in giving and then taking away. Our system would be greatly improved if a patent for an invention could be made incontestible with respect to many defenses, as is the case for trade-marks under the new law which goes into effect on July 5, 1947. A patent granted by the Government for an invention should be as reliable as a patent granted for land or a mining claim. No reasonable person proposes that the government subject each landowner or each mine claimant to a suit to test his rights of exclusive use, as against the public.

We need more and better patents. We don't need stronger attacks upon them.

E. G. KOERPER.[14]

TO THE EDITOR:

In his comments on my article "The Patent Situation and Society," Mr. Koerper proclaims the virtues of free competitive enterprise, praises our incentive patent system in contrast to the Russian system, and deplores our Government's practice of "giving and then taking away" patent rights. These are but echoes of the very sentiments expressed in my article, although Mr. Koerper fails to say so. On the contrary, he gives an opposite impression—that I am not a friend of our patent system, impliedly characterizing my article in MECHANICAL ENGINEERING as an "attack" on patents.

My many years of practice as patent lawyer, and my writings on patents and economics, provide the best evidence of the high value I place upon our patent system's contribution to modern technology. And those who have read my recent book "The 21st Century Looks Back" know that I am a proponent of an utterly free economy as opposed to a controlled economy.

What I do oppose is obviously not our patent system, but rather the *abuses* that have sprung up therefrom—abuses that have been recognized by the Supreme Court of the United States. These abuses relate to those practices which employ the precious patent monopoly to create a strangle hold on our economy. When it is considered that the only monopoly specifically authorized by the Constitution is that for intellectual property such as inventions, it becomes obvious that by closely watching this special grant to prevent abuses of the privilege, the Government is merely observing our basic policy against restrictive monopolies.

Mr. Koerper has completely missed the point. He is confused both as to the meaning of my proposals and as to the proper role of patents in an economy of abundance. Either he doesn't recognize the existence of the abuses that have been pointed out by the Supreme Court, or he is a victim of the propaganda of those who would let our patent system stagnate under the vitiating effects of an economy of scarcity.

There is a vast difference between the drastic proposals for unrestricted compulsory licensing, to which I am utterly opposed, and the limited system which would apply only where a patent owner or licensee does not exploit his invention as to *all* its uses and in *all* possible territory. In such a case only the *unexploited* uses and *unexploited* territories would be open to others, after an initial grace period of, say, five years, and upon the payment of royalties.

Such a system could do no possible harm to those who *use* their patents. And I believe the average American manufacturer would welcome a system that encourages further uses and more extensive exploitation of patented inventions.

Limited compulsory licensing of the type proposed in my article does not involve the elimination of the exclusivity or monopoly aspect of a patent, inasmuch as exclusivity will be accorded the patentee for all uses and all territory exploited or capable of being exploited by him; and as to other territory and other uses, his monopoly is evidenced by his right to collect royalties for such licensed exploitation by others.

Suppression of patents is not characteristic of American enterprise. But it is naive to believe that there are no artificial and deliberate deterrents to the full exploitation of patented inventions. Suppression does exist in various degrees. It is practiced wherever there is an agreement to limit production or artificially to maintain high prices—both being expedients to keep products out of the public's hands. It is practiced by those who oppose the introduction of labor-saving machinery, and by those who desire to avoid the expense of substituting new methods for their technologically obsolete but workable apparatus and processes; it is practiced by whole industries which resist competitive technological improvements. These are all obstacles to a free economy and barriers to free competition.

As to Mr. Koerper's suggestion to make patents incontestable, he is confusing the theory of trade-marks with that of the patent monopoly. But even as to trade-marks, the new law provides only limited incontestability; and where would he draw the line as to contestability and incontestability of letters patent? Besides, any provision for incontestability of patents would obviously have to provide for the public's right to inspect and oppose patent applications! And that would mark the beginning of a new series of abuses.

Instead of incontestability, we should broaden the base for patentability by including minor inventions, and provide, through legislation, specific objective tests, as outlined in my article.

We need more and better patents. We don't need attacks on every proposal to bring our patent system in line with the existing trend toward an economy of abundance.

E. R. POSNACK.[15]

[14] Research and Engineering Laboratories—Administration, A. O. Smith Corporation, Milwaukee, Wis. Jun. A.S.M.E.

[15] Patent lawyer, M.E., L.L.B., New York, N. Y.

A.S.M.E. BOILER CODE

Proposed Revisions and Addenda to Boiler Construction Code

IT IS the policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revisions of the rules and its codes. Any suggestions for revisions or modifications that are approved by the Committee will be

recommended for addenda to the code, to be included later in the proper place.

The following proposed revisions have been approved for publication as proposed addenda to the code. They are published herewith with corresponding paragraph number to identify their location in the various sections of the code and are submitted for criticism and approval from anyone interested therein.

It is to be noted that a proposed revision of the code should not be considered final until formally adopted by the Council of the Society and issued as pink-colored addenda sheets. Added words are printed in SMALL CAPITALS; words to be deleted are enclosed in brackets [ ]. Communications should be addressed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York 18, N. Y., in order that they may be presented to the Committee forconsideraton.

PAR. P-102(**h**) (and corresponding provisions in Pars. L-102(**h**) and U-68(**h**). Revise as follows:

Item (3). Delete

Item (4)(*c*). Add the following:

When the weld reinforcement and/or backing strip is not removed a shim shall be placed under the penetrameter such that the total thickness being radiographed under the penetrameter is the same as the total thickness through the weld, including backing strip when not removed.

Replace items (5), (6), (7), and (8) by the following:

The film during exposure shall be as close to the surface of the weld as practicable. If possible, this distance shall be not greater than 1 in. In any event, the ratio

$$\frac{\text{Distance from source of radiation to weld surface toward radiation}}{\text{Distance from weld surface toward radiation to film}}$$

shall be at least 7 to 1 in.

Item (10). Replace the word "stamped" by "marked."

Item (11). Replace by the following:

The radiographs shall be submitted to the inspector with such information regarding radiographic technique as he may request;

Item (12). Revise first section to read:

The acceptability of welds examined by radiography shall be judged BY THE FOLLOWING STANDARDS [by comparing the radiographs with a standard set of radiographs, reproductions of which may be obtained by purchase from The American Society of Mechanical Engineers. In general the standards of judgment shall be:]

Item (12) (*c*). Revise to read:

(*c*) Welds in which the radiographs show porosity shall be judged as acceptable or unacceptable by comparison with A [the] standard set of radiographs, REPRODUCTIONS OF WHICH MAY BE OBTAINED BY PURCHASE FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

PAR. P-200(**c**). Modify item (1) of this paragraph as it appears in the February issue of MECHANICAL ENGINEERING, to read:

(1) The stays shall be inserted into holes through the sheet, except as provided in (5), and the area of the weld in shear MEASURED PARALLEL TO THAT PORTION OF THE STAY EXTENDING THROUGH THE SHEET shall be not less than 1.25 times the required cross-sectional area of the stay, but in no case shall the size of the weld be less than $^3/_8$ in.

PAR. P-258. Add the following to the first section:

Specific requirements for access openings in certain types of boilers appear in other paragraphs.

PAR. P-264. Revise last three sentences to read:

Except on a vertical fire-tube boiler, there shall be a manhole in the upper part of the shell or head of a fire-tube boiler over 48 in. in diameter when the distance from the top of the tubes to the inside of the shell exceeds 20 in. The manhole may be placed in the head of the dome. Fire-tube boilers that do not have a manhole above the tubes shall have four handhole openings, two at each end of the boiler on opposite sides and above the top row of tubes.

PAR. P-286. Revise first sentence to read:

A safety valve over 3 in. in size, used for pressures greater than 15 psi gage, shall have a flanged inlet connection OR A WELDING INLET CONNECTION.

PAR. P-286. Add the following as (*b*):

(*b*) Safety valves may be attached to drums or headers by fusion welding provided the welding is done in accordance with Code requirements.

PAR. P-289. Revise last sentence to read:

The valve shall have a flanged inlet connection, OR A WELDING INLET CONNECTION [and] IT shall have the seat, etc.

PAR. P-292. Revise first section to read:

Each water-gage glass shall be equipped with a top and a bottom shutoff valve of such through-flow construction as to prevent stoppage by deposits of sediments, [and to indicate by the position of the operating mechanism whether they are in open or closed position.] If stop cocks are used, they shall be of a type with the plug held in place by a guard or gland AND THE PLUG SHALL BE MARKED IN LINE WITH THE PASSAGE. IF THE LOWEST VALVE IS MORE THAN 7 FT ABOVE THE OPERATING FLOOR, THE OPERATING MECHANISM SHALL INDICATE BY ITS POSITION WHETHER THE VALVE IS OPEN OR CLOSED. The pressure-temperature rating shall be at least equal to that of the lowest set pressure of any safety valve on the boiler drum and the corresponding saturated steam temperature.

Figs. P-2, L-9, and U-15. To be replaced by Fig. Q-6 of Section IX of the Code.

Tables P-7 and U-2. The allowable working stresses for Grade P 5b of Specification SA-158 will be the same as for Grade T 13 of Specification SA-213, and for Grade P 15 of SA-158 they will be the same as for Grade T1a of SA-209.

PARS. A-34 to A-36. Under the title of the Suggested Rules for Existing Installations insert: "This section is intended to apply only to boilers which do not carry the Code symbol."

Material Specifications The following specifications will be revised to make them identical with the latest A.S.T.M. specifications indicated: SA-27 (A 27-46T), SA-30 (A 30-46), SA-48 (A 48-46), SA-53 (A 53-46), SA-83 (A 83-46), SA-105 (A 105-46), SA-106 (A 106-46T), SA-129 (A 129-46), SA-135 (A 135-46), SA-158 (A 158-46T), SA-178 (A 178-46), SA-181 (A 181-46), SA-182 (A 182-46), SA-193 (A 193-46), SA-194 (A 194-46), SA-201 (A 201-46), SA-202 (A 202-46), SA-203 (A 203-46), SA-204 (A 204-46), SA-206 (A 206-46T), SA-209 (A 209-46), SA-210 (A 210-46), SA-212 (A 212-46), SA-213 (A 213-46), SA-217 (A 217-46T), SA-225 (A 225-46), SA-226 (A 226-46), SA-249 (A 249-46), SA-250 (A 250-46), SA-251 (A 251-46T), SA-280 (A 280-46aT), SB-11 (B 11-46), SB-12 (B 12-46), SB-42 (B 42-46), SB-43 (B 43-46), SB-61 (B 61-46), SB-62 (B62-46), SB-75 (B 75-46aT), SB-96 B (96-46), SB-98 (B 98-46), SB-111 (B 111-46), SB-126 (B 126-46T), SB-171 (B 171-46), SB-178 (B 178-46T).

A.S.T.M. Specifications for Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (Plates 2 in. and Under in Thickness) (A 285-46T) will be incorporated in Section II as Specification SA-285. This specification replaces Specifications SA-70 and SA-89, which will be dropped from the Code.

A.S.T.M. Specifications for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Electrodes (A 298-46T) will be incorporated in Section II as Specification SA-298.

Specification SA-283. The note preceding Par. 1 will be revised to refer to A.S.T.M. Specifications A 179-46.

PAR. U-68(**g**). Revise footnote[1] to read:

[1] Where two test plates are welded as a continuation of the longitudinal joint of different shell rings intended for the same vessel or when intended only to represent welding on girth joints and to be welded concurrently with the vessel, and by the same operator in either case, such plates shall be considered as the same test plate.

PAR. U-73(**c**). Modify proposed revision of second sentence as published in the February issue of MECHANICAL ENGINEERING as follows:

Circumferential and other joints of vessels uniting the plates of the shell, or other pressure parts, except as provided for in Par. U-59, covered by Par. U-69 shall be of the double-welded butt type, except that for thicknesses of $^5/_8$ in. or less they may be of the single-welded butt type and for inserted heads with pressure on the convex side only and SHELL THICKNESS DOES NOT EXCEED $^5/_8$ IN. [maximum allowable working pressure not to exceed 300 psi], they may be as shown in Fig. U-18(*c*).

FIG. U-18. Modify proposed revision of this figure as published in the February issue of MECHANICAL ENGINEERING by changing the note for sketch (*C*) to read:

Permissible only for Par. U-70 vessels and /or Par. U-69 vessels of a shell thickness not exceeding $^5/_8$ in. Pressure on convex side of head only.

PAR. U-201. Add the following:

The hammer test as specified in Par. U-77(**b**) shall be made under a hydrostatic pressure of not less than $1^1/_4$ times but not more than 2 times the maximum allowable working pressure.

Table UA-8. Revise as follows:

TABLE UA-8(a) GASKET MATERIALS AND CONTACT FACINGS

GASKET FACTORS (m) FOR OPERATING CONDITIONS AND MINIMUM SEATING STRESS y.

GASKET MATERIAL		GASKET FACTOR m	MIN SEATING STRESS y	SKETCHES AND NOTES	REFER TO TABLE UA-8(b): FACING LIM.	REFER TO TABLE UA-8(b): USE COL
Rubber without fabric or a high percentage of asbestos fibre: Below 75 Shore Durometer		.50	0		USE (1)(4)(5) ONLY	II
Rubber without fabric or a high percentage of asbestos fibre: 75 or higher Shore Durometer		1.00	200			
Asbestos, with a suitable binder for the operating conditions	1/8 Thick	2.00	1600			
	1/16 Thick	2.75	3700			
	1/32 Thick	3.50	6500			
Cloth inserted soft rubber		.75	50			
Cloth inserted hard rubber		1.25	400			
Rubber with asbestos fabric insertion, with or without wire reinforcement	3 - ply	2.25	2200			
	2 - ply	2.50	2900			
	1 - ply	2.75	3700			
Vegetable fiber		1.75	1100		○○○	
Spiral - Wound Metal, Asbestos Filled	Carbon Steel	2.50	4000		USE (1a) ONLY	
	Stainless Steel	3.00	6000			
Serrated Steel	Asbestos Filled	2.75	3700			
Corrugated Metal, Asbestos Inserted or Corrugated Metal, Jacketed Asbestos Filled	Soft Aluminum	2.50	2900			
	Soft Copper or Brass	2.75	3700			
	Iron or Soft Steel	3.00	4500			
	Monel or 4 - 6% Chrome	3.25	5500			
	Stainless Steels	3.50	6500			
Corrugated Metal	Soft Aluminum	2.75	3700			
	Soft Copper or Brass	3.00	4500			
	Iron or Soft Steel	3.25	5500			
	Monel or 4 - 6% Chrome	3.50	6500			
	Stainless Steels	3.75	7600			
Flat Metal Jacketed Asbestos Filled	Soft Aluminum	3.25	5500			
	Soft Copper or Brass	3.50	6500			
	Iron or Soft Steel	3.75	7600			
	Monel or 4 - 6% Chrome	4.00	8800			
	Stainless Steels	4.25	10100			
Grooved Iron or Soft Steel with or without Metal Jacketed	Soft Aluminum	3.25	5500		USE (1a) (4) (6) ONLY	
	Soft Copper or Brass	3.50	6500			
	Iron or Soft Steel	3.75	7600			
	Monel or 4 - 6% Chrome	4.00	8800			
	Stainless Steels	4.25	10100			
Solid Flat Metal 1/8" Thickness or more (For thinner Gaskets See note)	Soft Aluminum	4.00	8800	NOTE FOR EACH 1/32 REDUCTION IN THICKNESS BELOW 1/8 INCREASE m BY .25, COMPUTE $y = 180(2m-1)^2$		I
	Soft Copper or Brass	4.75	13000			
	Iron or Soft Steel	5.50	18000			
	Monel or 4 - 6% Chrome	6.00	21800			
	Stainless Steels	6.50	26000			
Ring Joint	Iron or Soft Steel	5.50	18000		USE (c) ONLY	
	Monel or 4 - 6% Chrome	6.00	21800			
	Stainless Steel	6.50	26000			

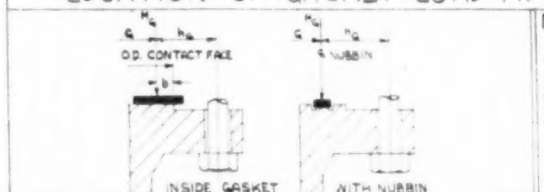
TABLE UA-8(b) EFFECTIVE GASKET WIDTH b

FACING SKETCH EXAGGERATED	BASIC GASKET SEATING WIDTH b_o: COL. I	BASIC GASKET SEATING WIDTH b_o: COL. II
(1a)	$\frac{N}{2}$	$\frac{N}{2}$
(1b)	$\frac{W+T}{2}\left(\frac{W+N}{4}\ \text{MAX}\right)$	$\frac{W+T}{2}\left(\frac{W+N}{4}\ \text{MAX}\right)$
(2)	$\frac{W+N}{4}$	$\frac{W+3N}{8}$
(3)	$\frac{W}{2};\left(\frac{N}{4}\ \text{MIN}\right)$	$\frac{W+N}{4};\ \left(\frac{3N}{8}\ \text{MIN}\right)$
(4)	$\frac{3N}{8}$	$\frac{7N}{16}$
(5)		
(6)	$\frac{N}{4}$	$\frac{3N}{8}$
(7)		
(8)	$\frac{W}{8}$	

EFFECTIVE GASKET SEATING WIDTH b

$$b = b_o, \text{ when } b_o \leq 1/4$$
$$b = \frac{\sqrt{b_o}}{2}, \text{ when } b_o > 1/4$$

LOCATION OF GASKET LOAD ATTACK



NOTE:
THE GASKET FACTORS LISTED ONLY APPLY TO FLANGED JOINTS IN WHICH THE GASKET IS CONTAINED ENTIRELY WITHIN THE INNER EDGES OF THE BOLT HOLES.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Westinghouse Centennial Forum

Science and Life in the World. The George Westinghouse Centennial Forum, Pittsburgh Pa., May 16–18, 1946. Vol. 1, Science and Civilization; the Future of Atomic Energy. Vol. 2, Transportation—A Measurement of Civilization; Light, Life, and Man. Vol. 3, A Challenge to the World. Whittlesey House, McGraw-Hill Book Co., New York, N. Y., 1946. Cloth, 6 × 9 in.; Vol. 1, 152 pp.; Vol. 2, 236 pp.; Vol. 3, 198 pp.; illus.; each vol., $2.50.

Reviewed by E. A. Salma[1]

THE George Westinghouse Centennial series of three volumes of verbatim transcripts of addresses delivered at the George Westinghouse Centennial Forum by leading scientists and educators, each an acknowledged expert in his field, is primarily a collection of facts, views, and opinions related to the state of scientific activity in our present civilization and its possible effects upon the further development of that civilization in the future. The manner of treatment of the subject of "Science and Life in the World" follows in general the usual pattern of a collective discourse on the glories of science in the past, the benefits of applied science enjoyed in the present, and by the same token the great possibilities which *may* be realized in the future. A sobering note is introduced into this discourse by the implications of the atomic bomb and the possibilities of biological warfare as a result of the scientific developments in these fields in recent years. It is evident that although further research into molecular structure and chemical reactivity is necessary for continued progress in biochemistry and the continued study of the microbiologist is essential to our continued well being, yet the potentiality of biological warfare as unfolded by these studies cannot be ignored in a search for a lasting peace.

It is indicated that in the fields of transportation and communications the unending quest for greater reliability, economy, and improvement in service will continue even though new problems in international political and economic relationships will manifest themselves in the fields of air and marine transport. It is to be hoped that in the light of the role played by aircraft in the past world conflict it may be possible to cast the airplane into the role of a civilizing force if there is a real desire to see it thus employed. To quote Dr. Edward Warner, the Aviation phase speaker at the Forum; "I can give you no guaranty that the airplane will improve the world. . . . It will still lie in the realm of human relations to determine whether the world is to be improved, but the airplane can contribute mightily to its improvement if it is in the hearts of its users to use it to that end."

The feeling of necessity for a revaluation of attitudes is more strongly expressed by Dr. J. Robert Oppenheimer who points out that the developments in nuclear fission resulting in the atomic bomb open new avenues of approach for that international co-operation so necessary in permitting the world-wide development of the possibilities of power production from nuclear fission as well as the purely scientific use of such developments as the employment of isotopes and radioactive materials as tracers in biochemical and industrial processes. A complete appreciation of the possibilities for both good and evil is necessary for mutual understanding in this respect.

Several indications as to the direction of our thinking and the form that our actions must take in order to avert disaster appear among the addresses. It is pointed out that there is an acute need for the restoration of the principles of self-discipline in the individual as well as the assumption of a personal sense of responsibility for his acts. Faith must be reaffirmed—not a materialistic faith, but one which embraces the basic spirit of mankind; one the avowed purpose of which is to seek understanding rather than material ends and the purposes of which are served only by a complete and free interchange of ideas.

A reading of these three volumes leaves one with a feeling of frustration which is entirely natural and rational. The complex problems of the day are competently stated but no solutions are offered. From a group with such a wealth of scientific background none could be expected. The present-day problems involving the impact of applied science on our civilization are of an extremely complex nature and simple solutions cannot be effected. It is to be hoped that the problem of the impact of science upon a society squirming under its benefits can be resolved by resorting to broadened powers of understanding rather than submission to the negation of armed conflict within nations or between nations.

[1] Assistant Professor of Mechanical Engineering, New York University, New York, N. Y. Mem. A.S.M.E.

Mechanical Measurements by Electrical Methods

Mechanical Measurements by Electrical Methods. By Howard C. Roberts. The Instrument Publishing Co., Inc., Pittsburgh, Pa., 1946. Cloth, $4^1/_2$ × 8 in., 357 pp., 254 figs., $3.

Reviewed by Paul Glass[2]

THERE is no doubt that throughout the far-flung field of measurements electrical methods are being relied upon to an ever-increasing extent. No matter whether a worker happens to be a physicist, a railroad engineer, or a medical researcher (to name just a few examples), he is using, or going to use, electrical measuring methods and instruments. A great amount of work has been done throughout the years in every branch of science and technology to perfect these methods of measurement, and a vast storehouse of knowledge is now available to assist in measuring a multitude of quantities.

However, a serious problem (though not confined to the field of measurements) presents itself. How can one find out whether a certain measuring principle has been explored, or whether a certain measuring problem has been solved before? It is far from pleasant—and most inefficient—to thumb through volumes of books and magazines hunting for the answer to a specific question. There is the further difficulty, particularly serious in the field of measurements,

[2] Research Engineer, Askania Regulator Company, Chicago, Ill.

that the title of a paper or book may completely conceal whether or not it can be of help in connection with a particular measuring problem. A publication on biological research, for instance, may contain the description of a measuring method most useful to, say, a structural engineer.

Still further, there may be a certain hesitancy on the part of some engineers to delve into highly specialized treatments on electrical measuring methods which may appear far removed from their own field of activity. How, then, can the gap be bridged which separates the measuring engineer from the storehouse of electrical-measuring knowledge?

Howard C. Roberts, in his book on "Mechanical Measurements by Electrical Methods," has undertaken the job of bridging this gap, and he has done it with remarkable success. Roberts was entrusted with the task by M. F. Behar, editor of *Instruments*, who clearly recognized the urgency and at the same time, complexity of the project.

In preparing his work, Mr. Roberts did the impossible of studying hundreds of references published here and abroad to review for himself the field of electrical methods as particularly applied to mechanical measurements. He was then faced with the still more important task of organizing the vast subject matter for presentation to his readers. Here, two objectives had to be met:

(1) The various measuring principles and their associated circuits and equipment had to be described; and

(2) the reader had to be given a guide to the approach of specific measuring problems.

Mr. Roberts accomplished this twofold task by devoting the body of his book to the first objective and by preparing a detailed index to meet the second.

More than half of the book is taken up by a description of the basic pickup devices or primary detectors, as used in electrical measuring methods. Devices based on the following principles are discussed: variation of a circuit parameter (capacitance, inductance, resistance), photoelectric, piezoelectric, thermoelectric, and other effects. In each case the underlying principle and associated circuits are described, supported by many well-prepared diagrams. In addition, the author outlines the limitations of each method, discussing sensitivity, accuracy, and stability to be expected. These paragraphs should prove of special value to the reader consulting the book for practical advice. Numerous references open the way to more intensive study. The remainder of Part 1 contains two chapters on bridge and potentiometer circuits which are so important in designing proper circuits for the various pickup devices, and, finally, a chapter on indicating and recording instruments.

Part 2 of the book is devoted to a description of auxiliary equipment, as calibrating devices, oscillographs, power supplies, and amplifiers. It closes with a description of a few representative complete measuring systems.

The index, rightly termed "Part 3" by Mr. Behar, provides an efficient help to those readers who wish to approach specific measuring problems. Under the title "Measurements" we find listed the great number of quantities covered throughout the book, beginning with acceleration and containing, beyond the realm of "mechanical" measurements, items like cloud height, firefly flashes, or muscular contraction.

It is natural in a work of this scope that not every wish could be fulfilled. A short but illuminating introductory chapter on basic concepts (sensitivity, accuracy, precision), supported by a few sketches and examples, would help the reader to more fully appreciate the following discussions. The treatment of pickup devices and associated circuits should be combined rather than separated wherever this leads to greater clearness of description and to the elimination of repetitions. While the first eight chapters are excellently supported by references, the remaining chapters, in particular chapters 9 to 12, are almost void of these valuable aids. The variable-inductance bridge, Fig. 151B, does allow true balancing throughout the travel range of the cores. This is evident if the correct balance condition

$$\frac{R_1}{R_3} = \frac{R_2}{R_4} = \frac{L_1}{L_3} = \frac{L_2}{L_4}$$

is used.

This book should be thought of not as the completion of a project but as a beginning. In view of the rapid development of the art, it is hoped that Mr. Roberts will find a way of continuing his work of bridging the gap between the measuring engineer and the ever-growing field of electrical measuring methods.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by A.S.M.E. members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

Plastics

PLASTICS HANDBOOK FOR PRODUCT ENGINEERS. By John Sasso. McGraw-Hill Book Co., Inc., New York, N. Y., 1946. Cloth, $5^3/_4 \times 9^5/_8$ in., 468 pp., 152 figs., \$6.

REVIEWS BY G. M. KLINE[3]

ENGINEERING data on plastics and synthetic rubber are compiled from various sources for product engineers in this guide to the selection, design, and processing of these materials. The tables and charts on the properties of plastics are reprinted from the Plastic Materials Manufacturers' Association book "Technical Data on Plastic Materials."

The data on synthetic rubbers are from articles by recognized authorities published in *Product Engineering*. The discussion of design is based on publications of W. S. Larson, the Bakelite Corporation, and the author. The chapters on the chemical background of plastics and synthetic rubber were prepared by P. O. Powers. The book furnishes a great deal of information in convenient reference form.

FUNDAMENTALS OF PLASTICS. Edited by Henry N. Richardson and J. Watson Wilson. McGraw-Hill Book Co., Inc., New York, N. Y., 1946. Cloth, $5^3/_4 \times 8^3/_4$ in., 483 pp., illus., \$5.

THIS book is based on a series of lectures delivered at the New Haven Y.M.C.A. Junior College, by specialists in the various phases of plastics as part of the ESMWT educational program. The relationship of the chemical structure of the plastics to their physical properties is first considered. This is followed by a review of the various materials classified in six groups—thermosetting resins, cellulosic thermoplastics, vinyl polymers, natural and synthetic rubbers, polyesters and polyamides, and silicon polymers. Chapters on various aspects of design, fabrication, and evaluation complete the coverage of the fundamentals of plastics. It is a well planned and authoritatively executed introduction to the field.

[3] Chief, Organic Plastics Section, National Bureau of Standards, Washington, D. C. Mem. A.S.M.E.

Books Received in Library

A.S.T.M. Specifications for Steel Piping Materials, prepared by A.S.T.M. Committee A-1 on Steel: Pipe, Tubes, Castings, Forgings Bolting. American Society for Testing Materials, Philadelphia, Pa., December, 1946. Paper, 6 × 9 in., 296 pp., illus., diagrams, tables, $3. (A.S.T.M. members, $2.25.) This compilation contains all the specifications for carbon-steel and alloy-steel pipe and tubing, issued by the Committee on Steel, and four jointly sponsored stainless-steel tubing specifications. These specifications cover: (1) pipe used to convey liquids, vapors, and gases at normal and elevated temperatures; (2) still tubes for refinery service; (3) heat-exchanger and condenser tubes; and (4) boiler and superheater tubes. Specifications are also included for the following related materials: castings, forgings, bolts, and nuts. Both classified and numerical sequence listings are given.

A.S.T.M. Standards on Glass and Glass Products, prepared by A.S.T.M. Committee C-14 on Glass and Glass Products. Methods of Testing, Specifications. November, 1946. American Society for Testing Materials, Philadelphia, Pa. Paper, 6 × 9 in., 86 pp., illus., diagrams, charts, tables, $1.25. (A.S.T.M. members, $0.95.) Definitions, specifications, and methods of testing of glass, glass containers, glass insulators, and glass textiles are presented. The twenty-six items cover both accepted and tentative standards and include a few selected ones prepared by other committees which are applicable in the glass industry.

A.S.T.M. Standards on Paper and Paper Products (with related information), prepared by A.S.T.M. Committee D-6 on Paper and Paper Products. Methods of Testing, Specifications. October, 1946. American Society for Testing Materials, Philadelphia, Pa. Paper, 6 × 9 in., 232 pp., illus., diagrams, charts, tables, $2. ($1.50 to A.S.T.M. members.) Seven specifications, for raw materials and finished products, and fifty test methods are contained in this compilation. The test methods cover a wide variety of properties of paper and paper products, including a group of tests on shipping containers made of paperboard or fiberboard. For information there are also two proposed tests for smoothness of paper and for bacteriological examination.

A.S.T.M. Standards on Petroleum Products and Lubricants (with related information), prepared by A.S.T.M. Committee D-2 on Petroleum Products and Lubricants; Methods of Testing, Specifications, Definitions, Charts, and Tables. American Society for Testing Materials, Philadelphia, Pa., December, 1946. Paper, 6 × 9 in., 615 pp., diagrams, charts, tables, $4. (A.S.T.M. members, $3.) The current edition of this annual publication gives in their latest approved form 99 test methods, 28 specifications, and 6 lists of definitions relating to petroleum, materials for roads and pavements, and rheological properties of matter. Important additions in this issue are numerous specifications and tests covering industrial aromatic hydrocarbons. There is an index and the customary classified and numerical sequence listings are included.

A.S.T.M. Standards on Textile Materials (with related information), prepared by A.S.T.M. Committee D-13 on Textile Materials. Specifications, Tolerances, Methods of Testing, Definitions, and Terms. October, 1946. American Society for Testing Materials, Philadelphia, Pa. Paper, 6 × 9 in., 490 pp., illus., diagrams, charts, tables, $4. (A.S.T.M. members, $3.) Some 80 specifications and test methods are included in the present edition of this annual compilation. Beginning in 1920 with the first standards on cotton fabrics, the field has been expanded to cover textile materials made from wool, rayon, silk, asbestos, bast, leaf, and glass fibers. Additional material appearing in appendixes includes tables of fiber properties, yarn number conversion, and relative humidity. Also appended are several proposed methods and specifications not yet formally approved by the Society. There are an index, a list of A.S.T.M. technical papers relating to textiles, and both numerical and classified lists of the standards.

Advanced Mathematics for Engineers. By H. W. Reddick and F. H. Miller, Second edition. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1947. Cloth, $5^1/_2$ × $8^1/_2$ in., 508 pp., diagrams, tables, $5. Assuming a knowledge of mathematics through the calculus, this book begins with the theory and standard methods of manipulation of ordinary differential equations. Succeeding chapters deal with various special functions, integrals, series and equations, with vector analysis, probability, and the operational calculus. To emphasize physical applications, problems are presented, with each principal topic, relating to the main fields of engineering. In this revised edition, an appendix has been added giving a brief discussion of dimensional analysis and systems of physical units.

Advanced Mechanics of Materials. By G. Murphy. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, 6 × $9^1/_4$ in., 307 pp., illus., diagrams, charts, tables, $4. This book is designed to guide the student in a critical analysis of his previous knowledge in the field, to extend his information along these lines, and to help him to develop an understanding which will enable him to apply his knowledge effectively. Topics covered include the relationships among stresses and strains at a point, theories of failure, axial loading, thick-walled cylinders, torsion, unsymmetrical bending, shear center, buckling, and stresses near concentrated loads. Emphasis is placed upon the fundamental tools—statics, geometry, and properties of the materials, and upon the way these tools are applied.

Applied Mathematics for Engineers and Physicists. By L. A. Pipes. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, $5^3/_4$ × 9 in., 618 pp., diagrams, charts, tables, $5.50. This text covers those topics of higher mathematics (series, differential equations, matrixes, special functions, vector analysis, etc.) which form the essential mathematical equipment of a scientific engineer or a physicist. The material dealt with is general in nature and includes the fields of electrical, mechanical, and civil engineering as well as the mathematics of classical physics. The mathematics of mechanical and electrical oscillations, electrical field theory, modern operational calculus, nonlinear oscillations, and potential field theory is clearly set forth. References accompany each chapter.

Audels Machinists and Tool Makers Handy Book. By F. D. Graham. Theo. Audel & Co., New York, N. Y., 1946. Fabrikoid, $4^3/_4$ × $6^1/_2$ in., 1126 pp., Sections B-E paged separately, illus., diagrams, charts, tables, $4. Section A of this practical manual first describes shop tools, methods of measuring, materials, and heat-treating processes. The essentials of the various machines are then taken up in succession, followed in each case by detailed instructions on all machining operations. The extensive use of line drawings and photographs effectively illustrates the text material. Drawing and blueprint reading are covered in Section B, shop mathematics in Section C, elementary physics and slide-rule calculations in Sections D and E. Technical data tables are included where they will be most useful.

Bibliography of Statistical Quality Control. By G. I. Butterbaugh, published for the Bureau of Business Research of the College of Economics and Business by the University of Washington Press, Seattle, Wash., 1946. Paper, 6 × 9 in., 114 pp., $1.50. The references contained have been carefully chosen to make certain that the statistical aspect is emphasized, and annotations are provided to assist the person consulting the list in selecting the most useful items. Part 1 lists magazine articles, arranged alphabetically by name of magazine and for each magazine consecutively by date of appearance. Part 2 lists manuals, monographs, and pamphlets alphabetically by the companies or organizations responsible, and Part 3 lists books by author. A combined author index for the more than 700 included items is provided.

Bellman Publishing Company (American Industries Series). No. 4. Aluminum Industry. By S. V. Malcuit. 36 pp. No. 5. Plastics Industry. By B. L. Crandall, 36 pp. No. 6. Refrigeration Industry. By D. C. Choate, 32 pp. Bellman Publishing Company, Boston, Mass., 1946. Paper, 6 × 9 in., illus., tables, $1 each. Three of a series of pamphlets intended to present an over-all account of a large number of basic American industries, as well as information about the "jobs" that comprise these industries. The job information part provides material on personal qualifications and scholastic training needed, remuneration, chances for advancement, possibilities for both men and women in the industry, and a statement of advantages and disadvantages. A feature of each pamphlet is the analytical index of occupations in the particular industry, with brief descriptions farther along of the duties of the various jobs listed.

Camouflage of 1939–42 Aircraft. By O. G. Thetford. Camouflage Publications, Ltd., Harborough Publishing Co., Ltd., London, England, 1946. Cloth, $5^1/_2$ × 9 in., 108 pp., illus., diagrams, 8s 6d. The use of color for airplane camouflage and insignia during the first half of the second world war is described in detail. An English publication, this book devotes over half the space to markings of British aircraft, although the air forces of all other combatant countries are included. The book is profusely illustrated by photographs, line drawings, and color plates. A second volume is to cover the period 1943–1945.

Cargo Aircraft. By W. W. Davies. Pitman Publishing Corporation, New York, N. Y., and Chicago, Ill., 1946. Cloth, 6 × $9^1/_2$ in., 216 pp., illus., diagrams, charts, tables, $6. The important aspects of this growing field are dealt with in considerable detail. The author assesses the air-cargo market and analyzes the characteristics of air cargo. Fundamental and detail considerations

of the design of cargo planes and their equipment are discussed from both the technical and economic viewpoints. Loading, handling, and stowage methods are covered, and summarized data on cargo flow and costs are appended. Likely developments for the immediate future are briefly indicated.

CASEY JONES CYCLOPEDIA OF AVIATION TERMS, compiled and arranged by H. L. Williams in co-operation with the staff of the Academy of Aeronautics, La Guardia Field, New York, N. Y., under the supervision of Aviation Research Associates. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, $8\frac{3}{4} \times 12$ in., 246 pp., illus., diagrams, charts, tables, \$5. This cyclopedic dictionary supplies detailed descriptions and definitions in nontechnical terms. The items are arranged in classified sections with an alphabetical index to the whole work. Extensively illustrated, the classified arrangement allows the inclusion of plates with the several sections showing the relation of certain items to other parts of the same structure or condition. All words and phrases have been included on a basis of a specific application to aeronautics.

ELEMENTARY THEORY OF GAS TURBINES AND JET PROPULSION. By J. G. Keenan. Oxford University Press, New York, N. Y., Geoffrey Cumberlege, London, England, 1946. Cloth, $5\frac{1}{2} \times 9$ in., 261 pp., illus., diagrams, charts, tables, 12s 6d. (\$5 in U. S.) This treatise presents the basic principles of the gas turbine in as simple a manner as possible while retaining the mathematical essentials. The concept of entropy is omitted, and the changes in the condition of the gas flow are dealt with on a pressure-volume basis. The history of the gas turbine is briefly traced, followed by chapters on the air cycle, compressors, combustion chambers, nozzles, heat exchangers, impulse and reaction turbines, gas-turbine efficiencies and calculations. Descriptions of installations for locomotives, ships, generating stations, and gas turbine-airscrew aircraft are given, with a special chapter on aircraft jet propulsion.

EXAMINATION OF INDUSTRIAL MEASUREMENTS. By J. W. Dudley, Jr. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, $5\frac{1}{2} \times 8\frac{1}{2}$ in., 113 pp., charts, maps, tables, \$2. This book acquaints engineers with simple and adaptable statistical techniques for the detection of variation in industrial products. Important types of data which reveal causes of variation are discussed, and effective methods for collecting, analyzing, and presenting them are explained. With special emphasis on broad industrial application, the book provides simple tools for constructing control charts, making quartile analyses, and analyzing limitations of data curves. Practical examples are given which also illustrate how reliable data can be distinguished from erratic data.

EXPLOSION AND COMBUSTION PROCESSES IN GASES. By W. Jost, translated by H. O. Croft. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, $6 \times 9\frac{1}{4}$ in., 621 pp., illus., diagrams, charts, tables, \$7.50. A translation of a classic German work, this book serves as an introduction to the field and is also of practical value to those doing research in allied fields. A broad theoretical basis has been provided as well as a detailed description of experimental work, allowing the physical chemist to draw his own conclusions. Important topics covered include spark ignition, the propagation of explosion, detonation, flame temperatures, kinetics of processes involved, combustion of oxygen-hydrogen mixtures, and combustion of hydrocarbons. There are a large number of footnote reference and a bibliography of comprehensive works.

FUNDAMENTALS OF PLASTICS, edited by H. M. Richardson and J. W. Wilson. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, $5\frac{3}{4} \times 9$ in., 483 pp., illus., diagrams, charts, tables, \$5. The purpose of this text is to give students a broad view of the plastics industry that will serve as a background for more detailed study. Of the four parts, the first deals with certain fundamentals regarding the relationship of chemical structure to physical properties. The second discusses the six classes of plastics, devoting a chapter to each major group. The third section covers the commercial methods used in the manufacture of plastic products; and the last section deals with the evaluation of plastics, including their measurement and manufacturing control.

GAS TURBINES AND JET PROPULSION FOR AIRCRAFT. By G. G. Smith. Fourth edition. Aircraft Books, New York, N. Y., 1946. Cloth, $5\frac{1}{2} \times 8\frac{3}{4}$ in., 256 pp., illus., diagrams, charts, tables, 12s 6d. (\$5 in U. S.) The principles of jet propulsion and the history of its development precede the chapters dealing with gas turbine components and construction systems. British, American, and German gas turbine types are described, and testing and maintenance procedures are dealt with. A discussion of jets versus airscrews is included, and various special types of aircraft are described as well as guided missiles and flying combs. Separate chapters consider the metallurgical problems connected with gas turbine construction, and present extracts of several papers dealing with the prospects of turbine unit propulsion.

HOW TO ORGANIZE AND MANAGE A SMALL BUSINESS. By N. Black. University of Oklahoma Press, Norman, Okla., 1946. Cloth, $5\frac{1}{2} \times 8\frac{1}{4}$ in., 367 pp., charts, tables, \$3. The reader is taken point by point through the problems, planning, decision, and action of small-business organization and management. Modern management methods are described, and techniques are explained for forecasting and preventing mistakes by the use of business ratio and percentage guides. Important features of the book are the emphasis on effective study of business fundamentals, and the discussion of methods necessary for adequate price-setting. Illustrative examples of particular types of small businesses are freely used.

MANUAL OF DESIGN FOR ARC WELDED STEEL STRUCTURES. Compiled by L. Grover. Air Reduction Sales Co., New York, N. Y., March, 1946. Fabrikoid, 6 by $9\frac{1}{4}$ in., 281 pp., illus., diagrams, charts, tables, \$2. The material in this manual is divided broadly into three sections. The first covers fundamentals of design, typical details, data, and diagrams for design calculations, the estimation of cost, and inspection methods. Part 2 presents standardized welded connections for simple framing, and tables of allowable loads on beams and piece marks for welded connections. Part 3 contains welding terms, definitions and symbols, acceptable and unacceptable weld profiles and joints, and condensed information on electrodes for structural welding.

MECHANICAL MEASUREMENTS BY ELECTRICAL METHODS. By H. C. Roberts. Instruments Publishing Co., Pittsburgh, Pa., 1946. Cloth, $5\frac{1}{2} \times 8\frac{1}{4}$ in., 357 pp., illus., diagrams, \$3. This new book describes in detail all the methods for electrically measuring displacements, pressure, vibrations, strains, accelerations, etc., including the basic principles of the circuits and systems. Capabilities and applications are discussed, and auxiliary devices, such as amplifiers, oscillographs, and calibrating devices, are dealt with as well as the main equipment. Several hundred footnotes and a supplementary bibliography indicate further available material in the field of electric gaging.

METALLURGY. By C. G. Johnson. Third edition. American Technical Society, Chicago, Ill., 1946. Cloth, $5\frac{1}{2} \times 8\frac{1}{2}$ in., 418 pp., illus., diagrams, charts, tables, \$5. This textbook is intended to provide a working knowledge of the manufacture and behavior of metals and their alloys. Early chapters discuss the properties of metals, iron and steel production, and the theory of alloys. The alloys of steel and of the more important nonferrous metals are dealt with at some length, and separate chapters are devoted to the shaping and forming of metals, heat-treatment, cast iron, and powder metallurgy. Physical metallurgy has been stressed rather than chemical metallurgy for practical reasons.

MEXICAN-AMERICAN CONFERENCE ON INDUSTRIAL RESEARCH, September 30–October 6, 1945. S. C. Pappageorge, Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill. Paper, 6×9 in., 176 pp., diagrams, charts, maps, \$2.50. The twenty-two papers presented at the Conference are printed here in full, describing representative types of university research, foundation research, Government research, and research in private industry in a wide variety of fields. General patterns of research, both national and international, are discussed, and the value of standards to American industry is briefly considered together with some descriptions of the work of two large standardizing bodies, the American Standards Association and the National Bureau of Standards.

MICROCALORIMETRY. By W. Swietoslawski. Reinhold Publishing Corporation, New York, N. Y., 1946. Cloth, $6 \times 9\frac{1}{4}$ in., 199 pp., illus., diagrams, charts, tables, \$4.75. The purpose of this book is to give a comprehensive description of the methods used in measuring small amounts of heat developed by different objects. The first ten chapters are devoted to principles, methods of operation, and equipment of various types of microcalorimeters, with discussion of their applications. The final chapter is concerned with the choice of a method with regard to the requirements of any given determination. Possible fields of use include physics, physical chemistry, physiology, biology, metallurgy, and industrial research.

MITTEILUNGEN AUS DEM INSTITUT FÜR BAUSTATIK an der Eidgenössischen Technischen Hochschule in Zürich, edited by M. Ritter and F. Stüssi. Verlag Ag. Gebr. Leemann & Co., Zürich, Switzerland, 1946. Paper, 6×9 in., illus., diagrams, charts, tables. No. 17. Das Ausbeulen der auf einseitigen, gleichmässig verteilten Druck beanspruchten Platten im elastichen und plastischen Bereich (Versuchsbericht), by G. F. Kollbrunner. 86 pp., 10 Sw. fr. No. 18 Schrumpfspannungen und Dauerfestigkeit geschweisster Trägerstösse, by F. Stüssi and C. F. Kollbrunner, 47 pp., 5 Sw.fr. No. 19. Das Tragvermögen der Druckgurte offener Fachwerkbrücken mit parallelen Gurtungen, by W. Schibler. 79 pp., 6 Sw.fr. Three communications from the Swiss Institute of Structural Statics present the results of careful and extensive research work on the following subjects: No. 17. The buckling of plates stressed by a uniformally dis-

tributed pressure applied to one edge, in the elastic and plastic region. No. 18. Shrinkstresses and fatigue strength of welded girder joints. No. 19. The load capacity of compression flanges of open-lattice girder bridges with parallel flanges.

MITTEILUNGEN AUS DEM INSTITUT FÜR HYDRAULIK UND HYDRAULISCHE MASCHINEN an der Eidgenössischen Technischen Hochschule in Zürich. Verlag Ag. Gebr. Leemann & Co., Zürich, Switzerland, 1946. Paper, $6^1/_2 \times 9^1/_2$ in., illus., diagrams, charts, tables. No. 1. Unterschungen über den Einfluss der Schaufelzahl auf die Wirkungsweise eines Freistrahlrades, by H. Fikret Taygun. 82 pp., 7.20 Sw.fr. No. 2 Der Einfluss der Schaufelzahl dez Laufrades auf den Wirkungsgrad bei Kreiselradmaschinen (Überdrucklaufräder), by M. I. Hassan. 69 pp., 7.50 Sw.fr. Two communications from the Swiss Institute for Hydraulics and Hydraulic Machinery describe the test methods and equipment, the necessary calculations, and the effective results of investigations on the following: (1) The influence of the number of blades on the mode of action of an impulse wheel (17, 20, and 23 blades respectively are considered); and (2) the influence of the number of blades of the runner wheel on the efficiency of turbines (figures for 11, 15, and 19 blades are given at the end).

NATIONAL FIRE CODES, Vol. 2. The Prevention of Dust Explosions, 1946. National Fire Protection Association, Boston, Mass. Cloth, $6 \times 9^1/_4$ in., 224 pp., diagrams, charts, tables, $1. Following a brief, general discussion of the fundamental principles for prevention of dust explosions in industrial plants, this manual presents seventeen specific codes for various industries. New in this edition is a code covering the plastics industry, and there is new appendix material on explosion venting and static electricity in addition to revisions to over half of the established codes. A record of dust explosions in the United States, classified by industry, is appended. This list does not include dust explosions in mines or ordnance plants.

NEW FIBERS. By J. V. Sherman and S. L. Sherman. D. Van Nostrand Co., New York, N. Y., 1946. Cloth, $5^1/_4 \times 8^3/_4$ in., 537 pp., illus., diagrams, charts, tables, $5. Both manmade fibers, such as rayon, and chemically improved natural fibers are covered, with the emphasis on what they can be made to do in comparison with the older-established fibers. The history and development, manufacture, processing, and properties of these fibers are discussed. There are chapters on the economic aspects of rayon; chemical treatments of textiles, and a classified list of new fibers suggested for various applications. An appendix contains a classified list of some 1600 patents issued in the United States in the last ten years. A broad discussion of research and development trends concludes the main text.

OIL FOR VICTORY, the Story of Petroleum in War and Peace by the editors of *Look*. McGraw-Hill Book Company, Inc. (Whittlesey House Division), New York, N. Y., 1946. Cloth, $6^1/_2 \times 10$ in., 287 pp., illus., $3.50. This story of the petroleum industry under the stimulation of the recent world-wide conflict is essentially the story of the people of all kinds and ranks, from the Chinese coolie on the Burma Road to Petroleum Coordinator Ickes, who contributed to the final success. The work of the oil hunters, the production crews, the refinery workers, the research technicians, and the road, rail, air, and water transportation is described in text and pictures. From "Big Inch" to U-boat raids, the high lights are shown as well, but the main story is the tough determination of those who kept the vital war fuel moving.

PETROLEUM PRODUCTION ENGINEERING, Oil-Field Development. By L. C. Uren. Third edition. McGraw-Hill Book Co., Inc., New York, N. Y., and London, England, 1946. Cloth, $5^3/_4 \times 9$ in., 764 pp., illus., diagrams, charts, tables, $7. This standard text covers every phase of petroleum-production engineering up to the point at which the wells are ready to produce. It sketches briefly the problems of petroleum exploration, discusses the principles and practices of oil-field development, and describes the methods and equipment used in modern well drilling. Special chapters are devoted to oil-field hydrology, fishing tools and methods, well completion, well records, and surveys. A selected bibliography accompanies each chapter and a list of illustrative motion-picture films is given. Oil-field exploitation is dealt with in a companion volume.

PETROLEUM PRODUCTION, Volume 2. The Optimum Rate of Production. By P. J. Jones. Reinhold Publishing Corporation, New York, N. Y., 1946. Cloth, $6 \times 9^1/_4$ in., 293 pp., diagrams, charts, tables, $4.50. Continuing the series begun with the author's "Petroleum Production; the Mechanics of Production," this volume deals with the various considerations which must be taken into account in determining the most favorable producing and operating methods for reservoirs or individual wells. These considerations include physical conditions; proportion of oil, condensatate and natural gas; period of development; rates of production and depletion; etc. Calculations are thoroughly demonstrated, with illustrative examples, throughout the book. Tables of interest factors, natural logarithms, and exponential functions are provided.

PLASTICS BUSINESS. By H. R. Simonds and J. V. Sherman. D. Van Nostrand Co., Inc., New York, N. Y., 1946. Cloth, $5^1/_2 \times 9$ in., 439 pp., illus., charts, maps, tables, $5. This new work, the result of the collaboration of a consulting engineer and an economist, deals primarily with the business and statistical aspects of the rapidly growing plastics industry. Certain technical features, such as the characteristics of the materials involved, are discussed, and the allied fields of plywood and synthetic rubber are briefly considered. The principal producers of plastic parts are classified and there is an alphabetical list of trade names.

RELAXATION METHODS IN THEORETICAL PHYSICS. By R. V. Southwell. Clarendon Press, Oxford, England; Oxford University Press, New York, N. Y., 1946. Cloth, $6 \times 9^1/_2$ in., 248 pp., illus., diagrams, charts, tables, $7 (20s abroad). The author's earlier treatise, "Relaxation Methods in Engineering Science," dealt with the application of these methods to systems of finite freedom (frameworks, electrical networks, etc.) and continuous systems (elastic beams) which are governed by differential equations in one space-variable. This second treatise applied the methods to problems governed by partial differential equations involving two space-variables, and by conditions which must be satisfied on boundaries of specified shape. The 24 examples which it treats in detail have been taken from elasticity, hydrodynamics, electricity, and magnetism, the conduction of heat, etc.; and they include systems characterized by symmetry with respect to an axis, to which (in general) the method of conformal transformation is not applicable.

SCIENCE, Its Effect on Industry, Politics, War Education, Religion and Leadership. By D. W. Hill. Chemical Publishing Co., Brooklyn, N. Y., 1946. Cloth, $5^1/_2 \times 8^3/_4$ in., 114 pp., $2.75. In a series of seven essays the author briefly discusses the scientific outlook and the effect of science on industry, politics, war, education, religion, and leadership. The object of the whole is to demonstrate that the application of the scientific method, or way of thinking, to these diverse fields can lead to social and economic, as well as technical progress, despite the inherent weaknesses and difficulties which exist.

SCIENCE REMAKES OUR WORLD. By J. Stokley. Ives Washburn, New York, N. Y. Revised edition, November, 1946. Cloth, $5^3/_4 \times 8^3/_4$ in., 318 pp., illus., diagrams, $3.50. In simple, nontechnical terms the author describes the scientific developments of recent years and shows how they affect our everyday life as well as the technical fields involved. The wide range of topics includes plastics, chemurgy, color photography, television, sulfa drugs and penicillin, jet propulsion, radar, and rockets. An insight into the future is provided in the material on helicopters, light that flows around corners, three-dimensional movies, and atomic power.

SIR WILLIAM J. LARKE MEDAL COMPETITION, Prizewinning Papers. Institute of Welding, London, S.W.I., England, 1946. Fabrikoid, $5^1/_2 \times 8^3/_4$ in., 156 pp., illus., diagrams, charts, tables, 12s, 6d. This volume comprises the five papers for which prizes were awarded by the British Institute of Welding in 1944. The five papers deal, respectively, with the following topics: applications of arc welding, embodying specific details; manipulators for arc welding, a discussion of machines for the support and positioning of workpieces; arc-welding fabrication from a practical point of view; production aspects in the fabrication of marine-engine constructions; copper welding as applied to the repair of locomotive fireboxes.

STORY OF THE ENGINEERS, 1800–1945. By J. B. Jefferys. Lawrence & Wishart, Ltd., London, England, 1946. Cloth, $5^1/_2 \times 8^3/_4$ in., 301 pp., illus., tables, cloth, 10s 6d. This book, essentially a history of the Amalgamated Engineering Union in Great Britain, describes the development of the engineering trades from the beginnings of the Industrial Revolution to the present time and the efforts of the skilled workmen to better their wages and conditions of work by the trade union system. The industrial relations aspects are emphasized, and the activities of the Union, of smaller groups, and of individuals are discussed in considerable detail.

SYMPOSIUM ON ATMOSPHERIC EXPOSURE TESTS ON NON-FERROUS METALS, Pittsburgh Spring Meeting, February 27, 1946. American Society for Testing Materials, Philadelphia, Pa. Paper. 6×9 in., 145 pp., illus., charts, tables, $1.75 (A.S.T.M. members, $1.35). The purpose of this Symposium is to give an evaluation and correlation of the great amount of data which has resulted from the long-time, country-wide atmospheric exposure tests on metals and alloys, particularly as carried out under the auspices of the A.S.T.M. Committee. Six papers by specialists are presented, with discussion, covering the effect of atmospheric exposure on nickel, monel metal, rolled zinc, copper alloys, lead, tin, and aluminum-base alloys, including a special paper on tracking troubles in atmospheric corrosion testing. Excerpts from the 1932, 1943, and 1944 committee reports are appended for reference purposes.

A.S.M.E. NEWS

And Notes on Other Engineering Societies

S. P. Timoshenko Awarded 1947 James Watt International Medal

STEPHEN PROKOP TIMOSHENKO, fellow A.S.M.E., 1935 Worcester Reed Warner Medalist, teacher, author, and mechanical engineer, will receive the 1947 James Watt International Medal, it has been announced by the Council of The Institution of Mechanical Engineers (Great Britain.)

Dr. Timoshenko is an international authority on stress analysis and vibration problems. His work in Russia and in the United States has done much to spur the teaching and research in the field of applied mechanics. He is a member of 13 engineering and scientific societies in the United States and Europe. As professor emeritus of theoretical and applied mechanics at Stanford University, Dr. Timoshenko is continuing his lectures on Applied Mechanics.

The James Watt International Medal was founded by the Council of The Institution of Mechanical Engineers in 1936 to commemorate the bicentenary of the birth of James Watt, who invented the separate condenser and made many contributions to the development of the steam engine. The award is bestowed every two years and is one of the highest international honors that a mechanical engineer can receive.

Dr. Timoshenko is well known to members of the A.S.M.E., not only as the author of many books on strength of materials and the theory of structures and elasticity, but also as a fascinating speaker who for two seasons lectured before A.S.M.E. Sections on "Stress Concentration and Fatigue Failures."

In 1935, while he was professor of mechanical engineering at the University of Michigan, Dr. Timoshenko was awarded the A.S.M.E. Worcester Reed Warner Medal "for his contributions to the theory of the design of elastic structures and the treatment of dynamics of moving machinery." In 1939 he was awarded the Lamme Medal of the Society for the Promotion of Engineering Education.

Dr. Timoshenko's love of teaching and his ability to speak simply about abstruse technical problems has endeared him to his students and stimulated his colleagues. On the occasion of his sixtieth birthday, associates and former students published "Stephen Timoshenko—60th Anniversary Volume" as a token of their regard for him and a measure of the importance of his contribution.

Story of a Useful Life

Dr. Timoshenko was born near Kiev, Russia, on Dec. 22, 1878, and obtained his engineering education at the Institute of Ways of Communication, St. Petersburg, Russia, from which he graduated in 1901. After traveling in Europe and studying under several teachers in Germany, he accepted the chair of applied mechanics at the Polytechnic Institute in Kiev.

STEPHEN TIMOSHENKO, RECIPIENT OF THE 1947 JAMES WATT INTERNATIONAL MEDAL

In 1907 his thesis on "Lateral Buckling of Girders" received honorable mention from the Société des Ingenieurs des Ponts et Chaussées, Paris, and was later translated into German and French.

Because of the social and political upheaval in 1917, he left St. Petersburg for Kiev, and later in 1920, he accepted the chair of applied mechanics at the Polytechnical Institute at Zagreb, Jugoslavia. Here he organized a laboratory for testing materials.

Finally, in 1922, the Vibration Specialty Company of Philadelphia, Pa., induced him to come to the United States as their consulting engineer. The following year he joined the research staff of the Westinghouse Electric and Manufacturing Company where he devoted himself to stress analysis and vibration problems. He became a citizen of the United States in 1927.

Considering himself primarily as a teacher, Dr. Timoshenko combined his research work with lecturing on various problems of mechanics. He organized group meetings where such problems were discussed, and passed on to his associates his enthusiasm for the study of applied mechanics.

In 1924 Dr. Timoshenko became a member of the A.S.M.E. His interest in free expression of scientific research led him to do much to participate in organizing the A.S.M.E. Applied Mechanics Division. His enthusiasm helped to make possible publication of the *Journal of Applied Mechanics.*

His love of teaching and his desire for leisure to devote to his writings led him to sever his active connection with the Westinghouse Electric and Manufacturing Company and to accept the post of professor of mechanical engineering at the University of Michigan. Later in 1936 he accepted the position of professor of theoretical and applied mechanics at Stanford University from which he retired in 1946.

Dr. Timoshenko is also a member of the American Association for the Advancement of Science, the American Society for Engineering Education, American Mathematical Society, Institute of Aeronautical Sciences, and many scientific societies in Russia, Poland, Germany, and Switzerland.

Author of Many Books

Among his books are: Theory of Elasticity; Theory of Structures; Strength of Materials; Engineering Mechanics, and others. His books have been translated into French, German, and Russian, and some have gone into several editions.

Dr. Timoshenko is the sixth recipient of the James Watt International Medal. Other recipients are: John A. F. Aspinall, honorary member A.S.M.E., 1937, Henry Ford, honorary member A.S.M.E., 1939, Aurel Stodola, honorary member A.S.M.E., 1941; A. G. M. Mitchell, 1943, and F. W. Lanchester, 1945.

Dr. Timoshenko will go to London to receive the Medal on April 26, 1947. He will lecture on "Stress-Concentration and Fatigue Failures."

JAMES WATT INTERNATIONAL MEDAL OF THE INSTITUTION OF MECHANICAL ENGINEERS

A. C. Hartley, British Engineer, Honored at Dinner by A.S.M.E.

A. C. HARTLEY, eminent British civil and mechanical engineer, who, as chief engineer of the Anglo-Iranian Oil Company, was responsible in large part for the success of the British cross-channel pipe-line project "Operation Pluto" and the landing-strip fog-dispersal project "Operation Fido," was honored by The American Society of Mechanical Engineers at a dinner held in the Biltmore Hotel, New York, N. Y., Feb. 19, 1947. Thirty-six members and guests were present.

Mr. Hartley is a director of The Institution of Civil Engineers and The Institution of Mechanical Engineers.

Planned as an American tribute to the skill and enterprise of the British engineering profession, the dinner was concluded with a toast proposed by Malcolm Pirnie, past-president, A.S.C.E., and chairman, E.J.C. Committee on International Relations to the ties of friendship that bind the two countries.

Eugene W. O'Brien, president A.S.M.E., who served as toastmaster, then called on Fenton B. Turck, member A.S.M.E., to introduce Louis A. M. Henry, director of the Belgian Institute for the Promotion of Applied Research in Industry and Agriculture, who is in the United States to arrange for an exchange of visitor's fellowships between the engineers of the United States and Belgium.

As a member of the Belgian Underground, Mr. Henry was captured with a two-way radio in his possession and was imprisoned in the notorious concentration camp at Dachau, Germany. Mr. Henry spoke quietly and movingly about his liberation by American troops and of his gratitude to the United States for aid given to Belgium.

Spectacular Films Shown

When the table was cleared and the room arranged for showing of motion pictures, Mr. Hartley described "Operation Pluto." He used slides to explain the construction of the pipe line and a colored film to show how the operation was actually carried out.

A detailed account of "Operation Pluto" was published on pages 527 to 529 of the August, 1945, issue of Mechanical Engineering.

Although the hour was late, Mr. Hartley was prevailed upon to continue with an account of "Operation Fido."

Others who attended the dinner were: B. R. Jackson and Mrs. Jackson, Col. B. H. Ingalls, Col. A. K. Eaton, Herbert Glasier, S. F. Dorey, F. S. Blackall, Jr., Alton C. Chick, R. M. Gates and Mrs. Gates, J. Noble Landis and Mrs. Landis, A. R. Mumford and Mrs. Mumford, George L. Knight, Mrs. Fenton B. Turck, W. N. Carey and Mrs. Carey, H. H. Henline and Mrs. Henline, E. A. Pratt and Mrs. Pratt, Joseph Pope and Mrs. Pope, Mrs. Malcolm Pirnie, C. E. Davies, Ernest Hartford, G. A. Stetson and A. F. Bochenek.

Itinerary Available

THE itinerary for the A.S.M.E. 1947 National Parks Tour is available and may be obtained by writing to headquarters. The all-expense tour has been planned by the Society for members who may wish to combine a vacation with the A.S.M.E. Fall Meeting to be held at Salt Lake City, Utah, Sept. 1 to 4, 1947.

AT THE DINNER HONORING A. C. HARTLEY, DIRECTOR OF THE BRITISH INSTITUTION OF CIVIL ENGINEERS AND THE INSTITUTION OF MECHANICAL ENGINEERS

(*Seated, left to right:* A. C. Hartley, Eugene W. O'Brien, S. F. Dorey. *Standing, left to right:* Alton C. Chick, J. Noble Landis, F. S. Blackall, Jr., and A. R. Mumford.)

Dr. C. E. Lucke Honored by A.S.M.E. Heat Transfer Division

THE following resolution of appreciation to Dr. Charles E. Lucke, fellow A.S.M.E., professor-emeritus of mechanical engineering, and one of the founders of the A.S.M.E. Heat Transfer Division, was read at the Heat Transfer Division Luncheon, Dec. 3, 1946, during the 1946 A.S.M.E. Annual Meeting:

Whereas: Dr. Lucke has had a lifelong interest and enviable record of achievement in that division of science known as heat transmission;

Dr. Lucke, as a member or the A.S.M.E., has for many years, worked to promote the interests of the Society membership in all fields of heat transmission;

In 1934, Dr. Lucke was instrumental in organizing a small group of A.S.M.E. members which became the Heat Transfer Committee of the Process Industries Division;

Patiently, paternally, but always modestly in the background, Dr. Lucke gave much of his time to guide this early Heat Transfer movement within the Society;

From the very beginning Dr. Lucke advocated an organization designed to cover the entire field of heat transmission as applied to mechanical engineering and this resulted in the formation of the Heat Transfer Professional Group on a broad organizational basis in 1937.

Dr. Lucke was always an advocate of high standards of excellence for papers sponsored by the Heat Transfer Group and the accomplishment of this aim together with the enrollment of a large number of members interested in this A.S.M.E. heat-transfer movement led to the attainment of full Professional Division status in 1941;

Dr. Lucke has during the past several years continued his activity and interest in the Division as a member of its Committee of Advisory Associates.

Now Therefore: The Executive Committee (1946) of the Heat Transfer Division of The American Society of Mechanical Engineers, does hereby declare this document a Resolution of Appreciation to our friend and fellow member, Dr. Charles E. Lucke on the occasion of the termination of his service as an Advisory Associate of this Division.

Stevens Institute Honors A.S.M.E. Members

CHARLES STEWART MOTT, member A.S.M.E., director, General Motors Corporation, Detroit, Mich., received the Alumni Award Medallion of the Alumni Association of Stevens Institute of Technology, at the Association's annual dinner, Hotel Astor, New York, N. Y., March 7, 1947.

Two other A.S.M.E. members, John Lyman Cox, chief engineer, Midvale Company, Philadelphia, Pa., and Charles Otto Gunther, professor of mathematics and ordnance engineering, Stevens Institute, were honored by having the Stevens Honor Award conferred on them.

A.S.M.E. Boiler Code Committee to Visit Texas and California

Public Hearings Planned

A party of 50 members and associates of the A.S.M.E. Boiler Code Committee will leave New York on April 29, 1947, for the Southwest, to attend two public hearings on the proposed revision of A.S.M.E. Code for Unfired Pressure Vessels, which is Section VIII of the A.S.M.E. Boiler Construction Code, the May meeting of the Committee, and the 1947 General Meeting of the National Board of Boiler and Pressure Vessel Inspectors.

At Houston, Texas, the group will be augmented by more than 200 engineers from the South and Middle West. In Los Angeles, Calif., the party will be joined by more than 400 engineers from most of the 48 states and many of the provinces of Canada, who are interested in all phases of boiler and pressure-vessel safety.

The first public hearing on the proposed revisions will be held at the Rice Hotel, Houston, Texas, on Thursday, May 1, at 8:00 p.m. and will continue on the following morning at 9:30. The meeting will be sponsored by the A.S.M.E. South Texas Section of which G. W. Lowther, Texas Gulf Sulphur Company, Newgulf, Texas, is chairman.

The second hearing will be held in the Biltmore Hotel, Los Angeles, Calif., Wednesday, May 7, at 9:30 a.m., and will be sponsored by the A.S.M.E. Southern California Section of which H. C. Reed, Union Oil Company, Los Angeles, Calif., is chairman.

The A.S.M.E. Boiler Code Committee urges all engineers interested in the proposed revision of Section VIII to attend the public hearings so that the final Code will reflect the best engineering practice.

Public hearings on proposed A.S.M.E. codes and major revisions to existing codes are one of the most important steps in the creation of a new code or a revision to an existing code. These hearings are in effect open forums before which manufacturers, users, enforcement authorities, and others interested in boilers and unfired pressure vessels, have an opportunity to express their views.

Section VIII, A.S.M.E. Unfired Pressure Vessel Code, now in process of revision, is one of nine safety codes which compose the A.S.M.E. Boiler Construction Code. Originally published in 1925 after several years of preparation, Section VIII has served as a guide to industry for more than 20 years. While the Code has been amended annually to keep it abreast of developments in fabrication techniques and metallurgy, this will be the first major over-all revision which aims to improve arrangement of material and incorporate latest advancements in the art.

To facilitate study and discussion of the Proposed Revision at the public hearings, copies are obtainable from headquarters for $1 per copy.

The National Board of Boiler and Pressure Vessel Inspectors will hold its general meeting at the Biltmore Hotel in Los Angeles, Calif., on Monday and Tuesday, May 5 and 6. Sessions will be presided over by Gerald Gearon, chairman of the National Board and chief deputy inspector of the City of Chicago. The National Board is composed of the chief boiler inspectors of those states and municipalities of the United States and provinces of Canada that have adopted the A.S.M.E. Boiler Code. Most members of the National Board are also members of the Conference Committee of the A.S.M.E. Boiler Code Committee, and in such capacity render a most useful service in the development and enforcement of the A.S.M.E. Boiler Construction Code.

The Boiler Code Committee will hold its meeting at the Biltmore Hotel on Friday, May 9. This meeting will be presided over by H. B. Oatley, chairman, member A.S.M.E. All those interested in the work of the Committee are invited to attend this meeting.

David Larkin's Day in Nebraska

WHEN David Larkin, regional secretary, A.S.M.E. Region VI, awoke in Omaha, Neb., Wednesday, Feb. 19, 1947, he braced himself for no ordinary day.

At noon he addressed a joint meeting of the A.S.M.E. Nebraska Section and the Engineers Club of Omaha. At three o'clock he was at the University of Omaha, speaking before 300 students and members of the faculty about the A.S.M.E. At five o'clock he was on his way to Lincoln, Neb., more than fifty miles away. At eight o'clock he was addressing the student branch of the University of Nebraska.

At long last, well after midnight, he was back in his room in Omaha. He had visited two Universities, made three speeches, and presented two Certificates of Award, one to John Winfield Kurtz, professor, University of Omaha, and the other to Wm. L. De Baufre, professor, University of Nebraska, for service as past-chairmen of the A.S.M.E. Nebraska Section, all in one day.

Mr. Larkin is a fellow of the A.S.M.E. He is a past-vice-president, past-director at large of the Society, and vice-president and manager, Broderick and Bascom Rope Company, St. Louis, Mo.

Metropolitan Section Plans "Spring Round-Up"

THE 1947 "Spring Round-Up" of the A.S.M.E. Metropolitan Section will be held at the Waldorf-Astoria Hotel, New York, N. Y., May 7, 1947. Tickets are $12.50 per person.

Checks should be mailed to The A.S.M.E. Metropolitan Section, attention, Miss M. O. England, 29 West 39th Street, New York 18, N. Y.

A.I.E.E. Nominations 1947 Officers

THE American Institute of Electrical Engineers has nominated the following for offices becoming vacant August 1, 1947:

For president, Blake D. Hull, chief engineer, Southwestern Bell Telephone Company, St. Louis, Mo.

For vice-presidents, G. W. Bower, Haddonfield, N. J.; J. H. Berry, Norfolk, Va.; I. M. Ellestad, Omaha, Neb.; D. I. Cone, San Francisco, Calif.; D. G. Geiger, Toronto, Ont., Can.

For directors, W. L. Everitt, Urbana, Ill.; A. C. Monteith, East Pittsburgh, Pa.; E. B. Robertson, Dallas, Texas.

For treasurer, W. I. Slichter, New York, N. Y.

A.S.M.E. BOILER CODE COMMITTEE IN ACTION

(*Foreground, left to right:* H. B. Oatley, chairman, V. M. Frost, P. R. Cassidy, Walter Samons. *Standing in right background,* D. B. Wesstrom. A.S.M.E. staff is seated in background.)

Bright Future Predicted for Industrial Southwest at A.S.M.E. 1947 Spring Meeting Held at Tulsa, Oklahoma, March 2 to 5

The South and Southwest has "greater undeveloped industrial possibilities" and "has gone ahead faster than any other section in the last 25 years" according to Eugene W. O'Brien, president A.S.M.E., who spoke at the Keynote luncheon, which officially opened the 1947 Spring Meeting of The American Society of Mechanical Engineers, held at the Mayo Hotel, Tulsa, Okla., March 2 to 5, 1947.

More than 250 engineers and industrialists from all over the United States participated in the four-day program planned about the theme, "Industrial Development of the Southwest."

Opening informally on Sunday, March 2, with a sight-seeing trip to the Will Rogers Memorial, Claremore, Okla., and points of cultural interest in Tulsa, the meeting swung into full stride on Monday, March 3, with a program of 13 technical sessions at which 25 papers were presented, three luncheons, a banquet, and visits to industrial plants.

Bright Industrial Future

At the opening luncheon held jointly with the Engineers Club of Tulsa, President O'Brien spoke on "Opportunity Lies About You." Referring to the national wealth of the Southwest, he said, "In its hills are coal, iron, and limestone for steel; in its ground over half of the solid fuel of this country and over two thirds of the liquid and gas fuel; in its rivers and lakes over half the water resources of the entire country."

Between 1929 and 1939 the South gained 32 per cent in the installation of prime movers—the ability to make power which is a basic factor in all industry, he said, whereas the rest of the country lost one per cent.

During the late war, Mr. O'Brien pointed out, the gains were even more emphatic. He predicted that the major gains yet to be made in the South will be along finished-product lines. With this raw material close at hand and its manufacturing facilities for finished products, the region has "the cream of business profits" still ahead of it. Since the war has largely erased the Southern wage differential no longer will the region labor under the stigma of "cheap labor."

Role of the Engineer

The engineer and scientist will play a major role in the future development of the Southwest, according to Harold Vagtborg, president, Midwest Research Institute, Kansas City, Mo., who was the main speaker at the banquet held March 4.

Dr. Vagtborg spoke on "Engineering in the Future Southwest."

The new industrial surge in the region offers unusual promise to engineers, he said. The tremendous drain of natural resources during the war has depleted most of the best ores in the region. There is not enough oil reserved for another war. Only by digging deeper, using lower-grade ores, and expanding the use of synthetics, can the industrial future be assured. All branches of engineering talent will be needed.

With the rich iron-ore deposits of the Mesabi range in North Minnesota diminishing rapidly and the recent discovery of iron-ore deposits in Missouri, the Southwest may look forward to profitable iron- and steelmaking operations.

The desire of American industry to get closer to raw materials and the desire of people to migrate to smaller cities and communities are factors favoring the Southwest. Dr. Vagtborg concluded by saying that all branches of engineering will contribute to the transformation of the Southwest from its "so-called wildness" to a throbbing industrial center of the future.

Jeopardy of Free Enterprise

Speaking before the Management luncheon on March 5, Elmo R. Thompson, vice-president, First National Bank, Tulsa, Okla., charged engineering management with responsibility for promoting constructive industrial legislation; seeking modification of many "inequities" in the laws; opposing "astonishing interpretations by the courts of certain laws," and the unreasonable and harsh administration of others.

Unless the inequities are removed by modification of the laws, our system of free enterprise will remain in jeopardy, he said. Only statesmanlike management assisted by engineering genius can provide jobs for all who are willing to work.

"Lawmakers cannot make jobs. Economists can only tell what caused something to happen that has already happened. Only management of business and engineers working together can make continuing jobs, and they must not fail. They have the first responsibility to use every sound argument, every persuasive appeal, every factual presentation, and an unbiased demand to cause constructive legislation, conducive to operation of business to be adopted.

Technical Sessions

More than 250 members and guests took part in the 13 technical sessions at which 47 authors presented 26 individual or joint technical papers on such subjects as power, aviation, oil and gas power, management, fuels, education, industrial instruments and regulators, petroleum, and metals engineering.

The power session on Monday evening presented a panel of 11 speakers who discussed the general subject of outdoor power plants. A. R. Smith, fellow A.S.M.E., managing engineer, turbine generator division, General Electric Company, Schenectady, N. Y., opened the panel discussion by describing the design and construction of his company's mercury plant which was designed and built for outdoor boilers and turbines and is currently being enlarged.

Two petroleum sessions on Wednesday, March 5, during which subjects of vital inter-

A.S.M.E. OFFICERS, MEMBERS, AND GUESTS WHO WERE AMONG THOSE WHO PARTICIPATED IN THE A.S.M.E. 1947 SPRING MEETING IN TULSA, OKLA.

(*Seated, left to right:* J. Calvin Brown, N. E. Funk, A. R. Mumford, W. H. Carson, Alex D. Bailey, Eugene W. O'Brien, president A.S.M.E., H. M. Cooley, S. R. Beitler, Linn Helander. *Standing, left to right:* W. Fred Stewart, W. H. Stueve, Carl A. Stevens, Guy F. Williams, Dean F. Foster, Ernest Hartford, Orval Lewis, C. E. Davies, H. F. Brindel, and D. E. Fields.)

est to the economy of the Southwest were discussed, attracted large audiences.

Off-Shore Drilling

In a paper on "Engineering Details of Off-Shore Drilling Operations," R. G. Watts, assistant chief engineer, Magnolia Petroleum Company, Dallas, Texas, told the Petroleum Session that the next few years "will see many more wells drilled in the Gulf waters and probably much farther out."

Mr. Watts said that his company was planning four new wells to be drilled within 10 miles of the shore and another nearly 20 miles into the Gulf. A drilling platform is now under construction 29 miles off shore.

Fuel Industry in Japan

William T. Reid, member A.S.M.E., assistant supervisor, Battelle Memorial Institute, Columbus, Ohio, in a paper on the fuel industry in Japan, said the difficulty in obtaining suitable catalysts prevented the Japanese from ever reaching a "flourishing status" with operation of the Fischer-Tropsch synthesis gas process.

Because of meager domestic supplies of petroleum, he said, Japan early in 1937 began an intensive development program on the production of synthetic liquid fuels from coal, but it was not until after the start of the war that commercial plants were constructed.

"Shortages of lubricants near the end of the war," he declared, "forced mine operators to install small-scale, low-temperature carbonization plants to recover coal tar from high-ash waste coals. The coal tar obtained was used directly as a lubricant for mine-car wheels and for the pulleys of the cable haulage systems in common use. However, it was low in lubricating value and useless in highly loaded bearings. Many attempts were made to produce semisolid greases by such procedures as adding bentonite or by processing the tar with gelatinous seaweeds and lime, but the greases so formed were of very poor quality compared to industrial lubricants having a petroleum base."

Industrial Facilities Inspected

Following the luncheon on Tuesday, at which John J. Grebe, member A.S.M.E., Monsanto Chemical Company, Oak Ridge, Tenn., spoke on "Future Industries of the Southwest," members and guests formed three inspection parties and spent the afternoon visiting typical educational and manufacturing facilities of Tulsa.

One group visited the Franks Manufacturing Company, where facilities for manufacturing portable well-servicing units, rotary drilling units, and portable studding units, were seen. At the Macnick Manufacturing Company, another group inspected facilities of producing time devices such as parking meters and time-bomb mechanisms. The third group visited the Spartan School of Aeronautics where every phase of aeronautical activity and complete schedule of aeronautical training were seen.

Committees

W. Fred Stewart, chairman, A.S.M.E. Mid-Continent Section, was general chairman of the meeting. He was assisted by the following committees:

Reception: L. T. Gibbs, chairman; D. A. Cant, J. H. Keyes, A. A. Hardy, and D. O. Johnson. Registration: C. O. Glasgow, chairman; S. H. Pope, and F. E. Pyeatt, Jr. Hotel: W. E. Bauman, chairman; L. W. Fagg, and W. P. Johnson. Technical Sessions: F. J. Daasch, chairman; C. H. Blue, W. B. McDermott, and W. C. Moody. Finance: O. L. Lewis, chairman; and D. E. Fields. Publicity: J. A. Wilson, chairman, and R. B. Tuttle. Entertainment: A. J. Hanssen, chairman; R. G. Ayers, D. E. Foster, and M. R. Wise. Plant Trips: R. A. Colgin, chairman; J. G. McIlhiney, H. E. Smith, Jr., and G. I. Wyckoff.

Four New A.S.M.E. Boards Begin to Function

FOUR of the A.S.M.E. administrative boards created at the 1946 Annual Meeting when the Council adopted changes to the By-laws of the Society, (see pages 147 and 148 February, 1947, issue of MECHANICAL ENGINEERING) recently held organizational meetings at which they discussed their fields of authority, formulated procedures, or submitted requests to Council for delegation of Council authority as defined in the modified By-laws.

The Board on Technology and the Board on Codes and Standards, having been organized under the old procedures, lost no time in formulating objectives and staking out areas of authority in which they are prepared to act for the Council.

Board on Technology

Accordingly, the Executive Committee at its meeting on February 20, 1947, delegated to the Board on Technology jurisdiction over such matters as decision on planning Society programs, rules governing educational exhibits, appointment of lecturers, financing schemes for professional division activities, research activities, publicity, Metals Engineering Handbook, *Metal Cutting Data*, and *Applied Mechanics Reviews*. Under this large grant of authority, the Board on Technology will be the center about which the technical life of the Society will revolve.

Board on Codes and Standards

Late in January, 1947, the Executive Committee delegated to the Board on Codes and Standards, the power to act in the name of the Council on questions of administration and policy of the four committees under its jurisdiction, and to approve or disapprove in the name of the Council, codes and standards originated by these committees.

Meeting on the same day in which it was vested with these broad powers, the Board discussed the procedure by which it would approve codes and standards. Disclaiming any intent of passing on the technical content of codes and standards submitted to it, the Board expressed its function as one of satisfying itself that the formulating Committee had followed the Board's procedure in formulating new or revised codes and standards. As a tentative measure, the Board accepted current procedures until it could formulate its own, as the basis for approval of new codes and revisions.

In accordance with the recommendation of the Nuclear Energy Application Committee, the Board asked the Secretary to go on record with the American Standards Association that the A.S.M.E. at an appropriate time intends to sponsor development of codes and standards in the field of nuclear-energy application.

Board on Education and Professional Status

The organizational meeting of the Board on Education and Professional Status was held at the Engineers Club, New York, N. Y., on Jan. 20, 1947. While the Board expressed the opinion that it was premature to ask for delegation of authority until it had a clearer concept of its function, several broad projects were discussed which indicated its likely line of action.

Junior Program Discussed

Among these was a Junior Program for 1947 looking forward to specific benefits to younger members of the Society. The Education Committee reported its plans for two sessions at the 1947 Annual Meeting during which eight junior members, selected by contest from each of the Regions, would present papers on "What Do We Expect and What Are Our Responsibilities?" and "The Introduction of the Junior Engineer to His Society, to His Job, and to His Community."

Board on Public Affairs

The Board on Public Affairs held its meeting on Feb. 6, 1947. Roy Wright, chairman A.S.M.E. Engineers Civic Responsibility Committee, reported that his committee was preparing a manual for the guidance of Sections and student branches in stimulating interest in civic responsibilities.

The Board expressed the opinion that any future problems affecting legislation would be referred by the Board to the Engineers Joint Council, which represents the five engineering societies.

Management Association for China to Be Studied

A GRANT of $10,000 has been made by the Research Corporation, New York, N. Y., for research and investigation in China aimed at establishing a management association in that country. The grant will be administered by the Stevens Institute of Technology, Hoboken, N. J., it was announced by Harvey N. Davis, fellow and past-president A.S.M.E., and president of the Institute. Joseph W. Barker, member A.S.M.E., is president of the Research Corporation.

The grant was made to help meet the need in China for modern management and production methods, a need recognized by Howard Coonley, associate A.S.M.E., and chairman of the executive committee of the American Standards Association, when he was in China in 1944–1945 as Donald Nelson's deputy, setting up the Chinese War Production Board.

John R. Freeman Scholarships Awarded to Chinese Mechanical Engineers

TWO Chinese graduate mechanical engineers, Chien Ting Hwa and James Chi Ma, are at the Iowa State College, Ames, Iowa, continuing their studies in agricultural engineering as the result of a $25,000 scholarship fund created in 1923 by the late John R. Freeman, president A.S.M.E. in 1905, world-renowned civil and mechanical engineer, who served as consulting engineer to the Chinese Government and was interested in the flood-control problems of that country. The fund is administered by The American Society of Mechanical Engineers.

Messrs. Chien and Ma are the eighth and ninth recipients of the John R. Freeman scholarship and the first Chinese engineers to study in this country as Freeman scholars.

Mr. Chien is a graduate of the National Central University, Chungking, China. He worked his way through the University by serving part time as a production superintendent at The Tah Kang Engineering Works, Chungking, China. Brought up by a farmer's family in a rural district of Kiangsu Province, Mr. Chien is familiar with the present farming methods and the problems of the Chinese farmer.

Mr. Ma is a graduate of the National Wu-Han University, Wuchang, China. He was studying Diesel power and the application of elementary tools to farm operations at the University of Michigan, Ann Arbor, Mich., when he was awarded the scholarship.

The Freeman Scholarship provides one year of study in a university or college of the recipient's selection and one year of experience in agriculture and industry. Both years are planned to give the recipient a sound basis of theory and practice in the design, manufacture, and use of agricultural implements and devices, particularly those adapted for best use under Chinese conditions. During this period the Society will be in touch with the scholars to advise them on their careers and problems. In addition to the first year's tuition, the Scholarship provides an allowance of $200 for travel, $150 per month for living expenses, and junior membership in the Society.

CHIEN TING HWA (*left*) GREETS C. E. DAVIES, SECRETARY A.S.M.E., AT HEADQUARTERS

Clarke Freeman, member A.S.M.E., son of the late John R. Freeman, is chairman of the Freeman Award Committee. Other members are Ely C. Hutchinson and Warren H. McBryde.

The Freeman Scholarship was created by the late Mr. Freeman to enable young engineers and junior professors between the ages of 25 and 35 to profit by a year or more of study in the best universities of Europe. Because of Mr. Freeman's work in the field of hydraulics, the first six Freeman Scholars were chosen for their interest in hydraulic studies. In 1944 the Freeman Award Committee decided to use the fund to train Chinese mechanical engineers in the mechanization of Chinese farms because of the late Mr. Freeman's interest in the welfare of China.

E.J.C. Panel Appears Before Congressional Committees

THE E.J.C. Panel on Labor Legislation appointed at the December, 1946, meeting of the Engineers Joint Council, appeared before the Senate Committee on Labor and Welfare on March 4 and before the House Committee on Education and Labor on March 8, to appeal for the right of engineers as professional employees to select their own bargaining agents.

Because engineers have been placed in the same class as nonprofessional workers by the National Labor Relations Board's interpretation of the Wagner Act, this right has been denied them.

The E.J.C. Panel suggested to both Committees that legislation should be enacted which would guarantee any group of professional employees, who have a community of interest and who wish to bargain collectively, the right to form their own bargaining unit. They asked that the legislation should protect professional groups from being forced to affiliate with any group including nonprofessional workers.

E. Lawrence Chandler, chairman, E.J.C. Panel, member A.S.C.E., said that the fundamental difficulty with the Wagner Act was that it does not distinguish "between professional employees and nonprofessional employees in spite of the fact that their viewpoints and abilities are inherently different and their conditions of employment cannot be made subject to a common standard."

He said that while the Act takes cognizance of skilled craftsmen and makes provision for recognizing craft units, it takes no corresponding recognition of the special problem of the professional employee.

William F. Ryan, fellow A.S.M.E., Stone and Webster Engineering Corporation, Boston, Mass., appeared with Mr. Chandler as A.S.M.E. representative on the Panel.

Other members of the E.J.C. Panel are: Gail A. Hathaway, War Department, member A.S.C.E.; W. I. Burt, B. F. Goodrich Chemical Company, Cleveland, Ohio, member A.S.Ch.E.; C. W. Ransom, General Electric Company, Pittsfield, Mass., member A.I.E.E.; Harry S. Rogers, president, Brooklyn Polytechnic Institute, Brooklyn, N. Y., member A.S.E.E.; and Ritchie Lawrie, Jr., consulting engineer, Harrisburg, Pa., member N.S.P.E.

While the American Society for Engineering Education and the National Society of Professional Engineers are not constituent members of the E.J.C., they were invited to participate by appointing representatives to the Panel.

In addition, Edmund R. Purvis, American Institute of Architects, accompanied the E.J.C. Panel and made presentations similar in principle on behalf of his organization.

A.S.M.E. Invites Industry to Recommend Engineers for Research Projects

A LIST of engineers who are qualified to serve on A.S.M.E. research committees is being sought by the Society as one of the steps in expanding the facilities for A.S.M.E. research.

Industrial organizations of national scope are being invited to co-operate with the Society by recommending engineers on their staffs as possible candidates for A.S.M.E. research committee assignments.

Secretaries of A.S.M.E. Sections and Professional Divisions are asked to contribute to the list by reporting the names of engineers in their groups who can be called upon to participate in the Society's research program.

E.J.C. Survey Reports 53 Per Cent Return on Questionnaire

TABULATION of 47,272 usable questionnaires returned in the 1946 survey of the engineering profession conducted by Engineers Joint Council is under way in Washington, D. C., according to word received from Andrew Fraser, consultant, acting for E.J.C. in liaison with the U. S. Department of Labor's Bureau of Labor Statistics. The returns are from the 86,900 members of the six leading engineering societies who received questionnaires, and represent slightly more than 53 per cent of the total number of questionnaires sent out.

Preparatory to compilation of a report based on the replies which will center to a great degree on the economic status of the engineer, Mr. Fraser has made a preliminary analysis which indicates that 12 per cent of the professional engineers in the country were

in the Armed Forces some time during the period 1939–1946, and that in general the Armed Forces used the special skills of professional engineers to a high degree.

The survey is sponsored by the Engineers Joint Council's Engineer Survey Committee, a subcommittee of the E.J.C. Committee on the Economic Status of the Engineer of which I. Melville Stein, member A.S.M.E. is chairman. Wm. N. Carey, executive secretary A.S.C.E., is chairman of the subcommittee. Co-operation of the Bureau of Labor Statistics was enlisted in the interest of economy, the Bureau being equipped to take care of the type of precoded questionnaire which was used.

Education Conference to Be Sponsored by D.E.M.A.

A one-week conference for professors of Diesel engineering, which combines tours of Diesel-engine factories, visits to mechanical-engineering-school laboratories, and classroom lectures, will be sponsored in Chicago, Ill., during the week of June 23, 1947, by the Diesel Engine Manufacturers Association with the co-operation of the Illinois Institute of Technology, Northwestern University, International Harvester Company, and the Electro-Motive Division, General Motors Corporation.

No entrance fee will be charged but the enrollment will be limited to fifty. Applications should be mailed to D.E.M.A., 1 North La Salle Street, Chicago 2, Ill.

A.S.M.E. Calendar

of Coming Events

May 21–24, 1947
A.S.M.E. Oil and Gas Power Division Meeting
Cleveland, Ohio

May 26–29, 1947
A.S.M.E. Aviation Division Meeting
Los Angeles, Calif.

June 12–13, 1947
A.S.M.E. Wood Industries Division Meeting
Madison, Wis.

June 16–19, 1947
A.S.M.E. Semi-Annual Meeting
Chicago, Ill.

June 23–25, 1947
A.S.M.E. Applied Mechanics Division Meeting
Schenectady, N. Y.

Sept. 1–4, 1947
A.S.M.E. Fall Meeting
Salt Lake City, Utah

Sept. 8–9, 1947
A.S.M.E. Instruments and Regulators Division Meeting
Chicago, Ill.

Oct. 6–8, 1947
Petroleum Committee of the A.S.M.E. Process Industries Division Meeting
Houston, Texas

Oct. 20–22, 1947
A.S.M.E. Fuels Division Meeting
Cincinnati, Ohio

Dec. 1–5, 1947
A.S.M.E. Annual Meeting
Atlantic City, N. J.

K. T. Compton Predicts Federal Support of Basic Research

K. T. COMPTON, member A.S.M.E., president, Massachusetts Institute of Technology, called Federal Government support of fundamental scientific research a "logical ultimate procedure," because of the tremendous cost of research and the unpredictability of results.

In accepting the Washington Award for 1947 conferred by the Western Society of Engineers and the Founder Societies, at the Continental Hotel, Chicago, Ill., Feb. 26, 1947, Dr. Compton predicted passage by Congress of a bill to establish a national science foundation which embodies the concept of federally supported research.

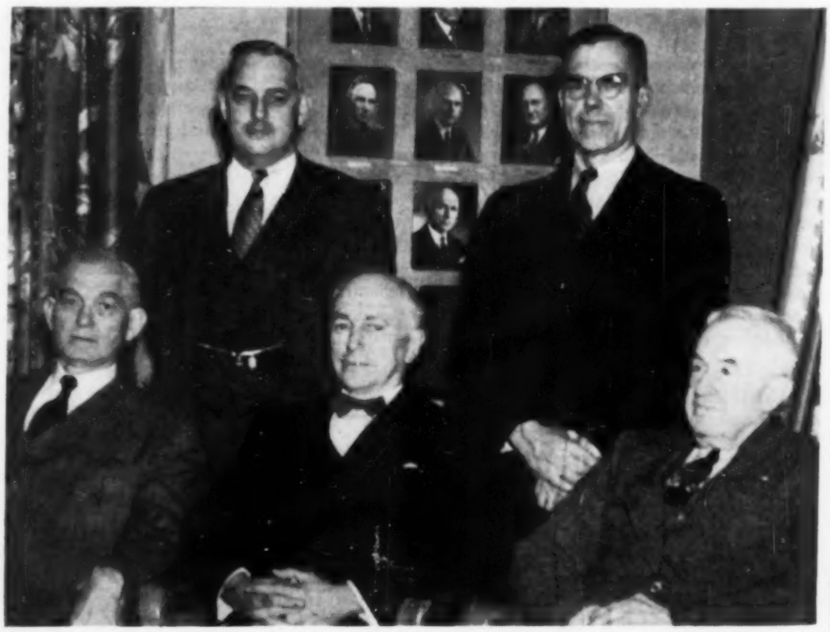
He said that the measure had bipartisan support and expressed belief that it would be "an act of real value to the people and to private enterprise generally, and that it can be operated on a high plane of public responsibility and support of free enterprise."

Dr. Compton also called for "the freest possible exchange of ideas among scientists," except where "national security is dangerously involved."

"This even goes, in my opinion, for patents," he said. "I hope that no patent policy for protection of inventors, or for protection of those who finance investors, may be permitted to slow up the free and prompt publication of really scientific discovery—not ingenious gadgetry, but scientific facts of nature."

"Briefing the Record" to Go Overseas

AS a convenient parcel of information reflecting contemporary American engineering thought and achievement, the Magazine Liaison Section of the U. S. Department of State recently asked permission of the A.S.M.E. to distribute regularly the "Briefing the Record" section of MECHANICAL ENGINEERING to the U. S. controlled press in the occupied countries of Germany, Austria, Japan, and Korea. This permission was given.



CIVILIAN MEMBERS OF THE A.S.M.E. NUCLEAR ENERGY APPLICATION COMMITTEE

(*Seated, left to right:* G. B. Pegram, professor of physics, Columbia University; A. D. Bailey, past-president, A.S.M.E.; W. I. Westervelt, consulting engineer. *Standing, left to right:* A. L. Baker, general manager, Kellex Corporation; and H. A. Winne, vice-president, General Electric Company.

At a meeting in New York, N. Y., Feb. 5, 1947, the Committee discussed plans for co-operation with the U. S. Atomic Energy Commission. Plans were also made for a joint meeting with the Power Division to be held at the 1947 A.S.M.E. Semi-Annual Meeting in Chicago, Ill. The meeting will hear discussions on problems of nuclear-energy power generation from the viewpoint of the engineer and the physicist.

Other members of the A.S.M.E. Nuclear Energy Application Committee are: Gen. H. S. Aurand, Admiral H. G. Bowen, Admiral T. A. Solberg, and Capt. J. B. Cochran.)

SHOP BUILDING UNDER CONSTRUCTION, SEPT., 1946, ROCKY MOUNTAIN HYDRAULICS LABORATORY

New A.S.T.M. Headquarters Dedicated

THE American Society for Testing Materials dedicated its new headquarters property at 1916 Race Street, Philadelphia, Pa., on Feb. 26, 1947.

Before a company of distinguished engineers and scientists, A. W. Carpenter, president, A.S.T.M., accepted the property in behalf of the membership and dedicated it to the "advancement of education and science and for service to industry and to the nation."

The three-story building was purchased and rehabilitated with funds contributed by members.

K. S. M. Davidson Awarded Wetherill Medal

KENNETH S. M. DAVIDSON, member A.S.M.E., director, Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J., has been awarded the John Price Wetherill Award of The Franklin Institute for his contributions to the improved design of ships through experiments on ship-hull models. Mr. Davidson will receive the award at the annual Medal Day ceremonies at the Institute, April 16, 1947.

The Wetherill medal is awarded "for discoveries or inventions in physical science, or for new and important combinations of principles or methods already known."

Martin Goland Wins Alfred Noble Prize

MARTIN GOLAND, junior member A.S.M.E., and chairman, engineering mechanics section, Midwest Research Institute, Kansas City, Mo., has been awarded the Alfred Noble Prize for 1946 for his paper "The Flutter of a Uniform Cantilever Wing." The same paper, which was published in the December, 1945, issue of the *Journal of Applied Mechanics* won for Mr. Goland the A.S.M.E. Junior Award for 1946.

Mr. Goland was educated at Cornell University from which he received an M.E. degree in 1940.

In 1944 he was awarded the A.S.M.E. Spirit of St. Louis Medal for his paper on "The Influence of the Shape and Rigidity of an Elastic Inclusion on the Transverse Flexure of Thin Plates."

The Alfred Noble Prize consists of a certificate of award and a sum of $350. It is awarded annually to a young member of one of the four Founder Societies or the Western Society of Engineers. The prize was established in 1929 and is administered by the A.S.C.E.

New Dean of Engineering at Iowa State College

J. F. DOWNIE SMITH, member A.S.M.E., has resigned as head of the engineering department of the United Shoe Machinery Corporation Research Division to accept a post as dean of engineering at the Iowa State College, Ames, Iowa, also director of the Iowa Engineering Experiment Station and the engineering extension service of the College.

Well known for his A.S.M.E. activities, Dr. Smith is a member of the executive committee, Rubber and Plastics Division, advisory member of the Machine Design Divisino, and a member of several A.S.M.E. research committees.

Dr. Smith assumed his new duties on March 15, 1947.

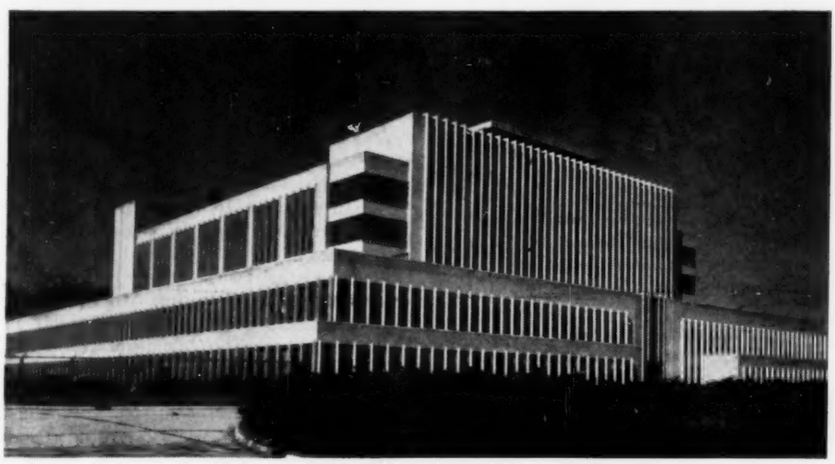
Outdoor Summer Laboratory Plans Second Season

THE Rocky Mountain Hydraulic Laboratory has announced that plans are now well under way for its second summer of research and educational activities. Students of hydraulics and members of the Hydraulics Sections of the American Society of Civil Engineers, The American Society of Mechanical Engineers, and the American Society for Engineering Education are welcome to participate in the 1947 program.

Organized as a nonprofit organization, the Laboratory owns a 20-acre site near Allenspark, Colo., near the Rocky Mountain National Park. The site includes a quarter-mile reach of a crystal-clear creek with a fall of nearly 80 ft and a discharge many times greater than ordinarily used in hydraulics experiments.

During the first season a small group of engineering "pioneers" opened up an access road, built a bridge, prospected for and found sand deposits large enough to take care of the laboratory's needs for construction and experimental work, and built a small shop building. All members of the group, which included C. J. Posey, State University of Iowa; Ralph W. Powell, Ohio State University; and John H. Dawson, University of Colorado, expect to return for at least part of the coming season to carry on the program started last summer.

Those who wish to participate in the Laboratory's program, should communicate with Prof. R. W. Powell, The Ohio State University, Columbus 10, Ohio, or Prof. C. J. Posey, State University of Iowa, Iowa City, Iowa.



MAIN BUILDING OF THE U. S. FOREST PRODUCTS LABORATORY, MADISON, WIS., WHERE THE A.S.M.E. WOOD DIVISION NATIONAL CONFERENCE WILL BE HELD JUNE 12–13, 1947

A.S.M.E. 1947 Semi-Annual Meeting Program Nears Completion

THE 1947 Semi-Annual Meeting of The American Society of Mechanical Engineers will be held at the Stevens Hotel, Chicago, Ill., June 16 to 19, 1947. In addition to a full program of technical sessions, the A.S. M.E. Chicago Section is arranging a series of plant-inspection trips to many industrial establishments in the Chicago area.

The local inspection-trip committee under the chairmanship of John P. Magos, is selecting plants representing as wide a variety of interests as possible so that all A.S.M.E. members will be able to select one or two of particular interest to their field. Trips will be conducted on Monday, Tuesday, and Wednesday afternoons, June 16, 17, and 18. Special buses will leave headquarters hotel at 2:00 p.m. and return before 5:00 p.m.

Stimulated by the demands of production of war materials, Chicago industry has greatly expanded and modernized its facilities. Plants closed to all visitors for the past six years now are opening their doors and are ready to show the progress which has been made. Industrially Chicago presents a wide variety of manufacturing and processing plants. Activities such as steelmaking and fabricating, food packing, power generating, electrical manufacturing, farm-equipment manufacturing, plastics fabrication, municipal sanitation, and many others are well represented in the Chicago area.

May 15, 1947, Dead Line for Reservations

There should be no housing problem at the A.S.M.E. 1947 Semi-Annual Meeting. The Stevens Hotel has set aside 750 rooms for A.S.M.E. members and has promised more if the demand is sufficiently great. One important condition was tied to the guarantee of rooms by the hotel. Members of the Society must make reservations on or before May 15, 1947, or the guarantee does not hold. After that date the hotel will not guarantee rooms. Members are urged to co-operate by making reservations early.

JOHN G. SHEDD AQUARIUM, CHICAGO, ILL.

Members of the A.S.M.E. Chicago Section plan to provide transportation to members and their guests for a Sunday afternoon drive along Chicago's 29-mile lake front, culminating in an evening of entertainment and dinner at the Michigan Shores Club, Wilmette, Ill. The entire facilities of the club have been made available for Sunday evening and members are urged to enjoy the excellent entertainment and supper which have been arranged for them.

Technical Program

Technical sessions on the following topics are being planned: Aviation, gas turbines, industrial instruments and regulators, fuels, fluid meters, furnace performance factors, heat transfer, machine design, power, process industries, management, metals engineering, oil and gas power, production engineering, railroads, education, materials handling, nuclear energy, and citizenship.

Committee

John R. Michel, Consolidated Edison Company, Chicago, Ill., is general chairman of general arrangements committee of the A.S. M.E. Chicago Section which is responsible for all local arrangements for the A.S.M.E. 1947 Semi-Annual Meeting. He is assisted by the following: Robert H. Bacon, general committee vice-chairman; Oliver F. Campbell, technical-sessions committee; Arthur B. Openshaw, entertainment committee; John P. Magos, inspection-trips committee; Vernon G. Leach, registration committee; W. T. McCullough, reception committee; B. H. Jennings, student-group committee; S. E. Winston, hotel committee; Howard F. Lane, print and signs committee; Mrs. A. B. Openshaw, women's committee; and C. C. Austin, publicity committee.

Notes on Reservations for A.S.M.E. Semi-Annual Meeting

A.S.M.E. members are urged to make reservations for the A.S. M.E. 1947 Semi-Annual Meeting, Stevens Hotel, Chicago, Ill., June 16–19, 1947, on or before May 15, 1947.

The Stevens Hotel, A.S.M.E. headquarters hotel, has guaranteed 750 rooms and more on the conditions that reservations are made on or before May 15. After that date the hotel will guarantee no rooms.

Unless members co-operate by observing this dead line for reservations, an unpleasant condition beyond the control of the Program Committee may develop.

According to the arrangement with the Stevens Hotel, the Society will take over 50 rooms on Saturday, June 14, and 500 rooms on Sunday, June 15. Special social events are planned for members and guests who arrive on Sunday.

Meetings and Expositions of Other Societies

April 8–11
American Management Association, Packaging Meeting and Exposition, Convention Hall, Philadelphia, Pa.

April 9–11
Society of Automotive Engineers, Aeronautic Meeting, Hotel New Yorker, New York, N. Y.

April 10–11
American Water Works Association, New York Section, Statler Hotel, Buffalo, N. Y.

April 14–18
American Chemical Society, 111th National Meeting, Hotel Traymore and the Convention Hall, Atlantic City, N. J.

April 16–18
Society of Automotive Engineers, Transportation Meeting, Hotel Stevens, Chicago, Ill.

April 17
American Society of Safety Engineers, Monthly Luncheon, Hotel George Washington, New York, N. Y.

April 17–18
American Water Works Association, Congress Hotel, Chicago, Ill.

April 18–19
The Society for the Advancement of Management, Time Study and Methods Meeting, Hotel Pennsylvania, New York, N. Y.

April 21–22
American Management Association, Production Meeting, Hotel New Yorker, New York, N. Y.

April 21–23
American Institute of Mining and Metallurgical Engineers, National Open Hearth and Blast Furnace Meeting, Netherland Hotel, Plaza Cincinnati, Ohio

April 21–25
American Ceramic Society, Annual Meeting, Convention Hall, Atlantic City, N. J.

April 23–26
American Society of Civil Engineers, Spring Meeting, Westward Ho Hotel, Phoenix, Arizona

April 25–26
American Water Works Association, Montana Section, Havre Hotel, Havre, Montana

May 5–6
American Management Association, Insurance Meeting, Hotel New Yorker, New York, N. Y.

May 7–9
American Water Works Association, Indiana Section, Antlers Hotel, Indianapolis, Ind.

Pittsburgh Section to Hold Mechanical Engineering Conference

THE Pittsburgh Mechanical Engineering Conference sponsored by the Pittsburgh Section of The American Society of Mechanical Engineering, will be held in the Keystone Hotel, Pittsburgh, Pa., April 22, 1947.

Fifteen papers will be presented at four technical sessions on the following subjects: materials handling, management, power-plant design, solid and liquid fuels, and lubricants and lubrication.

Co-operating in the Conference will be the Materials Handling Society, American Society for the Advancement of Management, the A.S.M.E. Management Division, and the Mechanical Section of the Engineers Society of Western Pennsylvania.

Eugene W. O'Brien, president A.S.M.E., will speak on "Our Interest and the Future" at the banquet meeting. He will be preceded by Thomas E. Purcell, member A.S.M.E., superintendent of power plants, Duquesne Light Company, Pittsburgh, Pa., who will speak on "Unionized Engineers—Yes or No?"

Sumner B. Ely, fifty-year member A.S.M.E., superintendent, Bureau of Smoke Prevention, Pittsburgh, Pa., will receive the Fifty Year Membership Badge from President O'Brien, in a ceremony following the dinner.

Two A.S.M.E. student members will present papers at the technical sessions. M. S. Heath, student member of the A.S.M.E. Carnegie Institute of Technology branch will speak on "Experimental Steam Turbine Layout" at the Power Plant Design Session. Alex F. Fino, student member of the A.S.M.E. University of Pittsburgh, will discuss "Methods for Storing Volatile Liquids" at the Fuels and Lubricants Session.

There will be no registration fee for the Conference. All engineers who may be in the the Pittsburgh area on business, are invited to participate.

A.S.M.E. to Trace Recent Engineering Graduates to First Jobs

TO ease the difficult transition every engineering graduate must make when he leaves the campus for his first job in a new locality, the A.S.M.E. has inaugurated a plan by which each A.S.M.E. Section will know in advance of his coming and the background and interests of recent graduates who will join the Section.

When commencement approaches, A.S.M.E. Section representatives will visit each student branch to invite graduating mechanical engineers to participate as junior members in the activities of the Society. With the co-operation of the honorary chairman and the student-branch president, cards will be obtained from graduating students listing their interests, first-job address, and permanent address. These cards will be sent to headquarters where they will be sorted and transmitted to the proper Section.

A Junior Advisory Committee appointed by each Section, will seek out new graduates, welcome them at Section meetings, and aid and encourage them to participate in the junior activities.

As a part of the membership development program, headquarters will consider sending Mechanical Engineering to the first-job or permanent address of those recent graduates who have not become junior members, but this part of the plan will depend on the easing of the critical paper situation.

Regional Delegates Consider Proposals for Changes in A.S.M.E. Procedures

DELEGATES of A.S.M.E. Sections are currently engaged in the annual series of Regional Administrative Committee meetings at which they discuss problems of A.S.M.E. regional administration and express opinions on proposals relating to recommended Council action or changes in Society procedure.

The final agenda of the 1947 Regional Administrative Committee meetings contains 17 items which are grouped into four headings: national Society organization, membership development, publications, and Section activities.

The agenda of the Regional Administrative Committee meetings is prepared by the Agenda Committee from items received from the 71 Sections. Each item is studied by the committee which prepares preliminary agenda composed of items which it considers worthy of consideration by the delegates. Reasons for rejecting any item are also given. The preliminary agenda are then returned to the Sections for their approval or rejection. For a place on the final agenda an item must receive the approval of 15 or more Sections.

A. C. Pasini, The Detroit Edison Company, Detroit, Mich., is chairman of the A.S.M.E. 1947 Agenda Committee. Other members are: A. Roberts, Jr., Lynchburg Foundry Company, Lynchburg, Va.; and R. Michel, Bureau of Ships, U. S. Navy, Washington, D. C.

Three Regional Administrative Committee meetings have already been held. Region III met at Lafayette College, Easton, Pa., March 25 and 26. Region I held its meeting at the Hotel Barnum, Bridgeport, Conn., March 27 and 28. Region II met in the Engineering Societies Building, New York, N. Y., April 1 and 2.

Other meetings will be held as follows: Region IV at the Atlanta Biltmore Hotel, Atlanta, Ga., April 7 and 8; Region VIII at the Albany Hotel, Denver, Colo., April 12 and 13; Region VII at the St. Francis Hotel, San Francisco, Calif., April 18 and 19; Region VI at the St. Paul Hotel, St. Paul, Minn., April 25 and 26; and Region V at the Statler Hotel, Cleveland, Ohio, April 30 and May 1.

Actions of the A.S.M.E. Executive Committee

At a Meeting Held at Headquarters, Feb. 20, 1947

A meeting of the executive committee of the Council was held in the rooms of the Society, Feb. 20, 1947. There were present: Eugene W. O'Brien, chairman; J. N. Landis, F. S. Blackall, Jr., A. C. Chick, A. R. Mumford, W. H. Sawyer (Finance); C. E. Davies, secretary; and Ernest Hartford, executive assistant secretary.

Board on Technology

A statement on organization, functions, and program drafted by the Board on Technology at its meeting on Feb. 11, 1947, was approved, and authority was delegated to the Board to carry out the proposed program.

Registration in Professional Divisions

Upon recommendation of the Professional Divisions Committee and the Board on Technology, it was voted to limit a member to registration in three professional divisions.

Special Research Committees

Upon recommendations of the Research Committee, it was voted to discharge with thanks the Special Research Committees on (1) Forging of Steel Shells, (2) Demolition Bomb Bodies, and (3) Finishing and Machining of High-Explosive Steel Shells.

These committees had been organized to supervise three contracts between the Ordnance Department, U. S. Army, and the Society for wartime projects dealing with the production of munitions.

Certificates of Award

The issuance of Certificates of Award to the following past-chairmen of Sections was noted:

Central Illinois Section: C. Bentley Brown, L. P. Weiner, E. D. Edwards, F. L. Meyer, C. G. A. Rosen, L. J. Fletcher, W. W. Babcock, R. T. Mees, and R. S. Stainton.

Central Indiana Section: L. W. Wallace, W. A. Hanley, E. H. Mayo, Charles Sargent, G. M. Bartlett, T. N. Wynne, A. A. Potter, J. T. Wilkin, F. C. Wagner, W. M. Taylor, Homer Rupard, D. B. Prentice, J. H. Maguire, F. C. Hockema, J. C. Siegesmund, C. M. Gross, J. A. Drogue, R. B. Bass, R. B. Holmes, M. E. Bechtold, Ferdinand Jehle, and H. L. Solberg.

A.S.M.E.-B.I.P.A.R.I.A. Co-Operation

Invitation from the Belgium Institute for Promotion of Applied Research in Industry and Agriculture for the A.S.M.E. to act as its representative in the United States in the interchange of travel and visitor fellowships for engineers, scientists, and industrialists of the two countries was noted. The Committee agreed to enter into an agreement with the Belgium Institute whereby the A.S.M.E. will advise the Institute of industrial and scientific centers in the United States which may be visited by Belgian engineers and also of American engineers and scientists who may be selected to go to Belgium on visiting fellowships.

Engineering Societies Year Book

Following discussion of the need for publication of an Engineering Societies Year Book to provide current information about many organized societies in engineering throughout the United States, the Committee authorized a loan from the Development Fund for the preparation and sale of such a publication.

Veteran's Handbook

A return of part of the money contributed for a compilation of a veteran's handbook entitled "Opportunity Unlimited—A Guide for Veterans Interested in the Construction Industry" 35,000 copies of which were distributed to veterans in the United States and many countries of the world, was noted.

Machine Design Division

Upon recommendation of the Professional Divisions Committee and the Board on Technology, it was voted to grant division status to the Machine Design Group.

Organization of Boards

The Committee noted that four Boards had held organizational meetings and asked that minutes of the meetings of all Boards be sent to members of the Council.

Tracing Engineering Graduates

A plan for tracing engineering graduates to their first jobs, proposed by the secretary, was approved.

Nonmembers on Committees

The Committee noted that nonmembers were being nominated for important technical-committee posts and expressed the opinion that while it recognized that aid of distinguished engineers in fields other than mechanical engineering is often needed on technical committees, nominations of nonmembers must be accompanied in the future with evidence of investigation to establish the fact that no A.S.M.E. member of equal standing was available for the committee assignment.

Appointments

The following appointments were approved:

Charles H. Dolan, secretary, Aviation Division.

Special Research Committees: Frederick Hymans, Elevators; D. F. Windenburg and J. L. Holmquist, Plastic Flow of Metals; Richard C. Corey, Furnace Performance Factors.

Alan Morris, Condenser Tubes; D. J. Purinton, Sectional Committee of Safety Code for Elevators; J. J. Zeitner, and A. W. Luce, alternate, A.S.A. Safety Code Correlating Committee;

I. S. Covington, liaison representative, Textile Division and Illuminating Society;

J. T. Rettaliata, American Association for Advancement of Science, Section M; Eugene W. O'Brien, John Fritz Medal Board of Award;

William F. Ryan, E.J.C. Legislation Panel.

T. S. McEwan, A.S.M.E. representative to Washington Award Dinner.

Sections

Competitive Papers Win First Prizes at Joint Meeting of Student Branch and A.S.M.E. Cincinnati Section

THREE first prizes was the only answer when members of the A.S.M.E. Cincinnati Section tried to pick by applause the best of three technical papers read before a joint meeting of the Section and the A.S.M.E. student branch of the University of Cincinnati held at the Herman Schneider Foundation, March 6, 1947.

The three speakers, Walter H. Friedlander, Gordon Zeidman, and John Kemeny, were so well received and generously applauded that Herbert S. Malany, vice-chairman in charge of program of the Section, charged with making the decision, had to declare—three first prizes; three junior memberships in the A.S.M.E.

The meeting was the first joint affair at which the Section planned the social program and the student members took over the technical program. Fifty members and guests and 30 student members were present.

Impressed with the papers and the presentation, Edward A. Muller, fellow A.S.M.E., and senior member of the Section, dropped the comment, "Now we have a scientific society way over our heads."

Following the dinner, Robert J. Short,

PRINCIPALS AT THE JOINT A.S.M.E. CINCINNATI SECTION—A.S.M.E. UNIVERSITY OF CINCINNATI STUDENT BRANCH MEETING
(*Left to right:* R. E. Lippert, W. H. Friedlander, H. B. Welge, H. S. Malany, R. L. Smith, R. J. Short, John Kemeny, J. C. Rodgers, and Gordon Zeidman.)

FIRST-PRIZE WINNERS RECEIVE AWARDS AT A.S.M.E. CINCINNATI SECTION MEETING (*Left to right:* H. B. Welge, John Kemeny, W. H. Friedlander, and Gordon Zeidman.)

chairman, A.S.M.E. Cincinnati Section, introduced Dean Albert C. Joerger, college of engineering, University of Cincinnati; Ralph E. Lippert, chairman, student branch; Prof. Ruel L. Smith, mechanical-engineering department, honorary chairman, student branch; James C. Rodgers, secretary, student branch; and Miss Betty Zukerman, the only attending woman of the student branch.

Chairman Short then introduced Mr. Muller, fellow A.S.M.E., who addressed the group briefly and proposed a toast to the thrill of professional achievement. Hans Ernst, fellow A.S.M.E., rose and reminded the group that "no matter how far we go, there are always new worlds to conquer, new paths to go on. No matter how far we go, it is only a prelude—this is the beginning of the play."

At this point Ralph E. Rippert, chairman of the student branch, took over the program of the evening. He thanked the Cincinnati Section for the opportunity offered in presenting a student program, and introduced the first speaker of the evening, Walter H. Friedlander, a senior. His talk, illustrated with slides, was entitled "Machine Noise and the Sound-Level Spectrometer." The second talk was presented by John Kemeny, also a senior, on "Elasticity—a Basic Factor in Metal Cutting." Gordon Zeidman, a junior, selected the subject "Combustion-Chamber Materials for Rockets," for his talk.

For his part in the program Mr. Lippert was awarded any engineering handbook of his choice.

Color Facts and Fantasies Topic at Akron-Canton Section

On Feb. 13 at the Y.M.C.A., Akron, Ohio, Norman F. Barnes of the General Electric Company, spoke on "Color Facts and Fantasies." Mr. Barnes showed how the three fundamental colors, red, yellow, and blue, would combine to make white or any other color desired. He described and illustrated the factors affecting color and its relation to our everyday life, and gave the methods for classification, definition, and measurement of color. Forty-four were present.

Anthracite-Lehigh Valley Section Hears Talk by C. F. Kottcamp

A dinner meeting on Jan. 24 at the Wyomissing Club, Reading, Pa., featured a talk entitled "The Coal-Burning Gas Turbine for Locomotive Service." The speaker was Charles F. Kottcamp, assistant to director of research, Locomotive Development Committee, Bituminous Coal Research, Inc. Mr. Kottcamp described plans for two locomotives now under construction, and their power plants, the various parts of which are being exhaustively tested in various testing laboratories. An audience of 70 joined in the discussion after the talk.

Baltimore Section Hears Dr. W. C. Schroeder

A dinner meeting was held on Jan. 27 at the Engineers Club of Baltimore, attended by over 100 members and guests. A large delegation from Annapolis, Md., was present, headed by Capt. H. A. Spanagel, Commandant, Postgraduate School, U. S. Navy. At the dinner Capt. Spanagel spoke briefly about plans for greatly expanding the activities of this school and transferring its headquarters to the West Coast.

The speaker of the evening was Dr. W. C. Schroeder, chief, Office of Synthetic Liquid Fuels, Bureau of Mines. His subject was "Synthetic Oil and Gasoline—European and American Developments." Dr. Schroeder pointed out that during the war we had supplied two thirds of the petroleum needs of the Allies, as well as our own, resulting in a very serious depletion of our oil resources. It was known, he said, that Germany was procuring the major portion of her petroleum products from coal by synthesis. In order to secure information on the latest developments, a group of petroleum engineers followed close behind the battle lines, to enter and study all synthetic-fuel plants as soon as they were captured. It was found that the majority of the oil was produced by high-pressure hydrogenation or the Fischer-Tropsch process. Dr. Schroeder described some of the intensive development work being done in this country by the Bureau of Mines to improve the hydrogenation and Fischer-Tropsch processes, and the extraction of oil from shales.

Boston Section Holds Large Meeting

On Feb. 27 at Northeastern University, Boston, Mass., an audience of 235 heard Robert E. Dexter, of Barkley and Dexter, consulting engineers, speak on "Special-Purpose High-Production Automatic Machinery." In his talk, Mr. Dexter used three typical examples of design work. He pointed out the innumerable problems which arise in production and showed how these problems could be solved. Mr. Dexter supplemented his talk by colored films of the operations of the machines designed for the three examples.

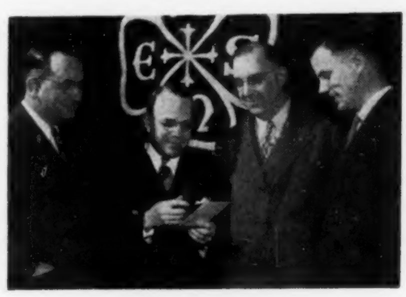
Central Illinois Section Meets with Peoria Section, S.A.E.

A joint dinner meeting of the Central Illinois Section and Peoria Section, S.A.E., was held on Jan 27 at the Hotel Jefferson, Peoria, Ill. The speaker was Stan Tucker, member A.S.M.E., associate editor, *Power*, who discussed "The Next Five Years of Gas-Turbine Progress." Mr. Tucker predicted that the automotive world will accept the gas turbine in place of the Diesel within 10 years. Reporting on late developments on the gas turbine, he said that the Swiss have developed a 4000-hp gas-turbine unit which produces the largest horsepower ever derived from a single unit. The largest Diesel, in comparison, he said, generates 3000 hp. He predicted that the first American gas-turbine locomotive will be "on the tracks by spring of 1948," and said "it will definitely be five to ten years before the gas turbine will compete with the Diesel." W. L. H. Doyle, member A.S.M.E., assistant director of research, Caterpillar Tractor Company, was technical chairman, and introduced Mr. Tucker.

At a dinner meeting in the Jefferson Hotel, Peoria, Ill., on Feb. 13, Dr. Ford K. Hick, associate professor of medicine at the University of Illinois Medical School, and M. K. Fahnestock, assistant director of the Engineering Experiment Station at the University, were the speakers. Their subject was the co-operation for the past ten years of the College of Engineering with the College of Medicine at the University, in problems involving variations in atmospheric environment, and the resulting effects on human beings. Through this co-operation there has been developed the Physical Environment Unit consisting of personnel and service equipment and facilities for the study of the physiological adjustment of man to changes in temperature, pressure, and humidity. Mr. Fahnestock gave the engineering aspects and phases encountered in modern atmospheric control or air conditioning. Dr. Hicks presented some of the results of the studies made to illustrate the adjustment of man to his surroundings.

Smashing the Atom, Topic at Central Indiana Section

On Jan. 10 a dinner meeting was held at Frances Hotel, Kokomo, Ind., with 75 mem-



SPEAKERS AT THE FEBRUARY MEETING OF THE A.S.M.E. CENTRAL-ILLINOIS SECTION (*Left to right;* M. H. Kronenberg, M. K. Fahnestock, Ford K. Hick, and R. E. McClain.)

bers and 25 guests present. M. E. Bechtold, junior member A.S.M.E., field engineer, Allis-Chalmers Manufacturing Company, Indianapolis, Ind., spoke on "Some Practical Industrial Applications of Machines Which Have Been Used in Smashing the Atom." Mr. Bechtold covered the history of the development of the cyclotron; the history of the development of the betatron; proposed developments of the synchrotron; other devices proposed for accelerating particles of matter to high velocities; and gave a demonstration of industrial radiographs made with the 20,000,000-volt betatron.

Aspects of the Atomic Bomb Related at Cleveland Section

On Feb. 7 in the Cleveland Engineering Society Building, Cleveland, Ohio, Col. John H. Lansdale gave an informal and interesting talk on "Some Aspects of the Atomic Bomb." He told of the work done on the atomic-bomb project in this country and abroad. Preceding the program, a dinner was enjoyed, at which members of the A.S.M.E. Woman's Auxiliary were present. Sixty attended the program.

Portland Cement Industry Topic at Colorado Section

A meeting was held on Feb. 14 at the Oxford Hotel, Denver, Col., with 51 present. The speaker was George Wiley, chief engineer of the Ideal Cement Company, who gave a talk entitled "The Portland Cement Industry." Mr. Wiley gave a brief history of Portland cement and its development, and a detailed description of the modern plants being built at Portland, Colo., and Devil's Slide, Utah, each of which plants will produce 5000 bbl per day. The speaker said that these plants will operate on the wet process requiring 1,000,000 Btu in fuel and 18 kwkr in power per barrel. Each plant will have two 10-ft-diam × 400-ft long rotary kilns. The Portland plant will use natural gas. The Devil's Slide plant will be pulverized-coal-fired.

Cincinnati Section Shares in Program Honoring Thomas A. Edison

On Feb. 11 the annual joint meeting of the Technical and Scientific Societies Council of Cincinnati, Ohio, was held, preceded by a dinner in the Masonic Temple. The program was held in the Taft Auditorium, and the central theme was the one-hundredth anniversary of the birth of Thomas A. Edison. Hon. J. G. Stewart, mayor of Cincinnati, gave the principal address of welcome. The speaker of the evening was Brig. Gen. David Sarnoff, president of the Radio Corporation of America, who asserted, as he eulogized Thomas A. Edison, that the sky is the limit on opportunity. "Let us scan the horizon of 1947 and compare it with that which the Edison pioneers beheld as they pushed forward across the old frontiers of the mechanical age. Edison's conquest was largely confined to wires, and mechanical and electrical machines. Today the frontiers of that science spread above and throughout the universe, far into unfathomed space—into that vast invisible fabric which separates the heavens and the earth."

In closing, the speaker said: "The world today needs a peace in which science will play the constructive role. The new forces which science has released must be made to serve the ends of peace." Among the A.S. M.E. members represented on the Council of Cincinnati, are F. W. Spalding, chairman of Council; H. Lowell Haworth, chairman of finance committee for the Feb. 12 meeting; R. J. Short, chairman, Cincinnati Section; and Willard L. Groene. Attendance was estimated at 1500.

Modern Printing Presses Subject at Dayton Section

On Jan. 22 at the Engineers' Club of Dayton, Ohio, Curtis S. Crafts, member A.S.M.E., vice-president and chief engineer, Goss Printing Press Company, Chicago, Ill., spoke on "Modern Printing Presses." Mr. Crafts explained the advances in web-fed letterpress and gravure printing presses, and said that increased speed and quality of four-color reproduction has resulted from application of new developments in many fields of engineering and science. The Harris-Seybold film "How to Make a Good Impression," was shown to illustrate the field of offset lithography. There were 175 in the audience. Preceding the program, a dinner was enjoyed by 69 members and women guests.

On Feb. 12 a joint meeting with the A.S.M. was held at the Engineers' Club. Hans Ernst, director of research, Cincinnati Milling Machine Company, spoke on "Recent Research in Machinability." Mr. Ernst covered an investigation relating to microstructure and tool life. His talk was illustrated with motion pictures and slides. The audience numbered 300.

Inspection Trip Enjoyed by Detroit Section

At the invitation of the Ford Motor Company, an inspection trip was made to their Rouge plant. Three hundred and ninety-seven men gathered at the Rotunda Auditorium where N. L. Bean, member A.S.M.E., and assistant director of production engineering, described just what would be covered on the trip. By bus the visitors were taken to the country machine shop, the engine assembly line, and the engine inspection and test department. Guides were provided. George Scranton, member A.S.M.E., assistant chief of the inspection department, answered questions regarding the Ford V-8 and the Ford 6 engines, and the methods used in machining, assembly, and inspection.

T. S. McEwan, A.S.M.E. Vice-President at Fort Wayne Section

The meeting on Feb. 6 in the Chamber of Commerce, Fort Wayne, Ind., featured a talk entitled "What's Ahead in Management." The speaker was T. S. McEwan, vice-president, A.S.M.E. Region VI. He presented certificates of award to all past-chairmen of the Section. The audience numbered 50.

Jet Propulsion Discussed at Hartford Section

On Feb. 18 at the City Club of Hartford, Hartford, Conn., Charles L. Fay, chief, Flight Research Section, Bell Aircraft Corporation, spoke on "Jet Propulsion. Mr. Fay, who has been closely associated with the development of two of the nation's jet-propelled aircraft, the P-59 and the XA-83, was well qualified to speak on the subject. The toastmaster was John Lee, assistant director of research, United Aircraft Corporation. A dinner preceded the program. One hundred and seventy-five members and guests enjoyed the talk.

Metropolitan Section Hears Talk on Petroleum Developments

Dr. John R. Bowman of the Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa., spoke before the Section on Feb. 26 in room 502 of the Engineering Societies Building, New York, N. Y., on "Advances in Distilling Petroleum Chemicals." After recounting the refining process in the early days of the petroleum industry, Dr. Bowman explained how at the turn of the century sharper separations were effected by the use of multiple redistillation, and shortly afterward bubble-plate rectifying columns came into use. He told of the demands made during the recent war, on the industry for pure chemicals required for the big three petroleum war products; aviation gasoline, toluene, and rubber. "Perhaps the most spectacular of these processes is the manufacture of butadiene for synthetic rubber," he said, "the rectifying columns required for this process being by far the largest ever built." Dr. Bowman asserted that the development of the principles in practice of modern thermal rectification has been done largely by the Petroleum Refining Fellowship at Mellon Institute, and that the Fellowship has also been active in development of the fundamental mathematical theory of countercurrent processes in general.

New Haven Section Meets with Bridgeport Section and A.W.S.

On Feb. 12 a joint meeting was held with the A.S.M.E. Bridgeport Section, and the American Welding Society. After a dinner at Ceriani's Cafe Mellone, New Haven, Conn., the audience went to The United Illuminating Company's auditorium to hear a talk on "New Developments in Welding," by Samuel L. Hoyt, technical adviser, Battelle Memorial Institute. Mr. Hoyt reviewed the history of the development of fusion arc-welding in the last 20 years, from the old bare-wire practice, through the development of cellulose rods, coated rods, and the modern assortment of specialized electrodes for various types of

GEORGE J. NICASTRO RECEIVES FIRST CERTIFICATE OF AWARD TO BE CONFERRED BY A.S.M.E. METROPOLITAN SECTION

(*Left to right*: H. Weisberg, A. R. Mumford vice-president, A.S.M.E. Region II; George J. Nicastro, and H. R. Kessler. Mr. Nicastro, who served as chairman of the Education Committee of the A.S.M.E. Metropolitan Section from 1935 to 1946, received the Certificate of Award from A. R. Mumford vice-president, A.S.M.E. Region II, in recognition of his long service. The presentation was made at a joint meeting of the Power, Fuels, Heat Transfer, and Metals Engineering Divisions of the A.S.M.E. Metropolitan Section held in the Engineering Societies Building, New York, N. Y., Feb. 18, 1947.)

applications. He devoted the major portion of his talk to reporting the results of investigations on the elimination of cracking when welding various types of steels which were formerly thought to be nonweldable. The speaker showed a number of slides to illustrate these conclusions regarding the elimination of hydrogen at the weld, proper heat-treatment, and composition of the material.

New London Section Hears Discussion on Industrial Drying

"Modern Developments of Industrial Drying" was discussed at the Feb. 19 meeting in the Mohican Hotel, New London, Conn., by B. R. Andrews, before an audience of 35. The speaker explained the various methods of drying textiles by means of steam, radiant gas heat, electricity, and dielectric heating. He said that cost in the order named was in the ratio of 1-4-7-35. Mr. Andrews said that while the cost of dielectric heating was prohibitive except for very thick materials, the process is inherently very satisfactory and has good possibilities for the future.

New Orleans Section Meets With Louisiana Engineering Society

A joint meeting was held on Feb. 10 with the Louisiana Engineering Society in New Orleans, La. The speaker was William J. Davidson, administrative engineer, technical center, General Motors Corporation, Detroit, Mich., who discussed "New Trends in Automotive Engineering." Frequently punctuating his talk with examples, both serious and humorous, from his vast experience in all parts of the world, Mr. Davidson made his talk one of the most interesting given to the Section in a long time, and graciously answered questions for over an hour after the completion of the program. There were approximately 140 present.

Ontario Section Visits Ajax Division, University of Toronto

On Feb. 19, 35 members and 65 guests made a plant trip through the Ajax Division, University of Toronto, Ajax, Ont. The speaker on the tour, Ralph Presgrave, discussed the results of industrialization, increased productivity, shorter hours, shorter working span, greater leisure time for workers. A dinner meeting preceded the plant trip.

North Texas Section Meets With A.I.E.E.

On Feb. 19 in the Dallas Power and Light Building, Dallas, Texas, a joint meeting was held with the A.I.E.E. The speaker was B. R. Prentis, executive engineering department, General Electric Company, Schenectady, N. Y., who gave a talk on "Application of Atomic Power," in which he said that atomic energy very probably will be propelling ships and submarines someday, and may possibly power very large piloted airplanes at some far distant date, but that it now appears improbable that it will prove suitable for railway locomotives, and not at all for automobiles. The most practical and certainly its first industrial use, Mr. Prentis said, will be in the creation of electric power, and even the first experimental plant of this kind will not be in operation for at least two years. The economic factor, too, still is an indefinite one. It is possible that in some cases oil, coal, water, and other present producers of electric power will prove cheaper than the new discovery. Two hundred and thirty-eight were in the audience.

Junior Group, Philadelphia Section Hears Talk on Atomic Energy

The regular monthly meeting of the junior group of the Section was held on Jan. 8 at the Engineers' Club, Philadelphia Pa. The guest speaker was Dr. Roy K. Marshall, director of the Fels Planetarium of The Franklin Institute in Philadelphia, Pa., and scientific editor for the *Philadelphia Evening Bulletin*. Dr. Marshall's subject was "Commercial Applications of Atomic Energy." He traced the development of research in radioactive materials, beginning with the discovery of radium through the development of the cyclotron, and the discovery, in 1938, of the possibility of splitting uranium atoms. He stressed the fact that these early elements were the contributions of scientists of many nationalities and were possible only through the exchange of scientific information between various countries.

Wilmington Sub-Section Entertains Student Engineers

On Feb. 26 a meeting was held in the Hob Tea Room, Wilmington, Del., at which members of the junior and senior classes of the University of Delaware's engineering department were guests of the Wilmington Sub-Section of the A.S.M.E. Philadelphia Section. These students were introduced by Dean David L. Arm, head of the University's engineering department, who said that research scheduled by various companies throughout the nation will require the continuous supply of 45,000 engineers each year.

D. Robert Yarnall, past-president A.S.M.E., spoke on "The Engineer in Public Affairs." Mr. Yarnall outlined the aims of the Society and their relation to its younger members. He urged the local section to develop a program and present information at its meetings that will attract the interest of the younger members of the mechanical-engineering profession.

Plainfield Section Hears Geo. E. Kidd

On Feb. 19 at the Elks' Club, Elizabeth, N. J., a talk was given by Geo. E. Kidd, chief mechanical engineer, Rohm and Haas Company, entitled "Development of Atomic En-

ergy and Possibilities for Peacetime Use." Mr. Kidd explained the extension of Newton's Laws to atomic physics; the structure of uranium and plutonium; gave landmarks in historical development; described construction and maintenance of piles for chain reaction, control of piles, and estimated cost of energy. Forty-five members and twenty guests were present.

Providence Section Asked: Why Don't Engineers Try to Understand People?

On Feb. 4 in the Providence Engineering Society Building, Providence, R. I., 40 members and 210 guests heard a talk entitled "Why Don't Engineers Try to Understand People?" by Allan H. Mogensen, of the Work Simplification Conference. Mr. Mogensen said that production is increased by making work easier rather than speeding-up; that participation of all persons affected by changes in devising, installing, and operating under better methods is required for success. A share in the gains by all, he said, assures wholehearted co-operation.

Dr. Albert Coates Speaks Before Raleigh Section

On Feb. 10 in the S & W Cafeteria, Raleigh, N. C., Dr. Albert Coates spoke on "The Institute of Government." He outlined how the Institute of Government is bringing together city, county, state, and federal officials who have a common goal, at meetings with discussions and planned programs, hoping to raise the efficiency of each agency, reduce the overlapping, inefficiency, and cost. Dr. Coates told of the successful meetings held by the tax officials, and the law-enforcement officers. One hundred and forty were in the audience.

A meeting was held on Feb. 25 at Duke Union, Duke University, featuring Dr. Fred Bellinger of Atlanta, Ga., who gave a talk entitled "Hydrogen Peroxide Power for Rockets." Dr. Bellinger was in charge of experimental work using hydrogen peroxide for the U. S. Army during the war. He explained possibilities of hydrogen peroxide as the fuel for rockets.

Rochester Section Meets with A.S.C.E. and R.E.S.

"Fire Safety in Hotels" was the subject discussed at the Feb. 20 meeting of the Section with the A.S.C.E. and Rochester Engineering Society, in the Hotel Sheraton, Rochester, N. Y. The speaker was Calvin G. Lauber, National Board of Fire Underwriters, who discussed the subject with particular reference to the Winecoff Hotel disaster in Atlanta, Ga. Enclosed stairways, sprinkler systems, and good housekeeping received important consideration. Eighty-four were present.

Rock River Valley Section Holds Joint Meeting

On Feb. 13 the Section held a joint meeting with the Rockford Engineering Society at the Top Hat restaurant, Rockford, Ill. James R. Keen, application engineer of Gisholt Machine Company, Madison, Wis., gave a talk entitled "Technique of Superfinishing." The speaker showed the advantages of superfinished surface over a ground surface. A discussion period followed the talk. Twelve Section members and 34 members of the Rockford Engineering Society were in the audience.

Talk on Color Interests St. Joseph Valley Section

On Feb. 11 at the Oliver Hotel, South Bend, Ind., Norman F. Barnes of the General Electric Company, gave a talk entitled "Color Facts and Fantasies," before an audience of 25 members and 75 guests. The talk was illustrated with color slides and spectacular demonstrations which were of great interest. The speaker discussed the important part color is playing in many new developments and gave an idea of the many uses color will have in the near future.

San Francisco Section Meets With S.F.E.C.

On Jan. 24 in the Commerce High School auditorium, San Francisco, Calif., a talk was given by Charles Patrick Cabell, chemical engineer, Hanford Engineering Works of General Electric Company, entitled "Atomic Energy for Power Generation." Mr. Cabell indicated the nature of the equipment employed in an atomic power plant as contemplated today. Some of the problems encountered—such as shielding of plutonium pile, disposal of spent fuel, health hazards, size of maintenance crews, were suggested. Secrecy prevented presentation of any truly technical information. Eight hundred attended the meeting.

J. R. Carlson, member A.S.M.E., central station steam engineer, Westinghouse Electric Corporation, Philadelphia, Pa., gave a talk entitled "Recent Developments in Steam and Gas Turbines," at the Feb. 12 meeting in the Commissioned Officers Club, Treasure Island, San Francisco, Calif.

Three Engineers Talk at Southern California Section Meetings

On Jan. 7 in Edison Hall, Los Angeles, Calif., John R. Carlson, member A.S.M.E., of the Westinghouse Electric Company, spoke on "Modern Steam and Gas-Turbine Design." Mr. Carlson said that he believed within 5 to 10 years public service stations would be installing gas turbines for first-cost economy and ease of control. One hundred and twelve were in the audience.

The meeting on Feb. 13 at the Rodger Young Auditorium, Los Angeles, Calif., had as speaker, Joseph S. Pecker, member A.S.M.E., consulting engineer, whose subject was "Functional Design for Customer Appeal." Mr. Pecker stressed the importance of research to determine possible markets; customer appeal; design from sales outlook as well as performance; and cost of manufacture. The value of packaging and customer presentation was also discussed. Sixty-six were present.

At the Pasadena Athletic Club, Pasadena, Calif., on Feb. 20, Dr. Robert T. Knapp gave a talk on "Cavitation," before an audience of 211. He described the research methods and equipment, and illustrated with moving pictures. Dr. Knapp said that the California Institute of Technology is making cavitation tests for the U. S. Navy. After the talk, all equipment was inspected in operation at the hydrodynamics laboratory, California Institute of Technology.

R. A. Brannon, Corrosion Engineer, Speaks at South Texas Section

On Feb. 12 at the Houston Engineers Club, Houston, Texas, a talk entitled "Trends in Protection of Pipe Lines From Corrosion," was given by R. A. Brannon, senior corrosion engineer, Humble Pipe Line Company. The speaker explained the conditions found in Texas, the consequence of corrosion, the various physical, chemical, and electrical protective methods and statistical results. With Mr. Brannon were some of his associates from his company, and together they presented an excellent motion picture of pipe-line reconditioning. A question-and-answer period followed.

Talk on Atomic Energy at Tri-Cities Section

On Feb. 25 in the chapel of Augustana College, Rock Island, Ill., Dr. A. L. Hughes gave a talk on "Atomic Energy" before 60 members and 40 guests.

Toledo Section Discusses German and Belgian Industry

At the meeting on Jan. 28 at the Toledo Edison Service Center assembly room, Toledo, Ohio, Lieut. Col. A. Hoefle, head of the System Operating Department of the Toledo Edison Company, spoke on "German Industry in the War." Many interesting points were brought out in the talk, including some of the history of the Allied Control Authority and how it was set up to include utilities specialists who were attached to the various army groups. These specialists took over control of utilities as fast as the armies liberated a city.

A Toledo Technical Council meeting sponsored by the Toledo Section of the A.S.C.E., was held on Feb. 5 at the Doermann Theatre, University of Toledo, Toledo, Ohio. Lewis C. McCabe, chief of the coal division, Fuels and Explosives Branch, Bureau of Mines, U. S. Department of the Interior, spoke on "Coal Mining in Belgium and Germany During the European Campaign." Eighty-five were present.

On Feb. 25 in the staff meeting room of the main library, Toledo, Ohio, James E. McCort, district manager, railway division, Timken Roller Bearing Company, Cleveland, Ohio,

gave a talk on "Mechanical Developments for the Railroads of Tomorrow." Twenty members and 34 guests from the Toledo Rail Fans Association and the Toledo Maumee Valley Railroad Club were present. Three sound films on railroads were first shown, entitled: "Modern Coal-Burning Locomotives," by Norfolk and Western Railroad; "Clear Track Ahead," by Pennsylvania Railroad; and "Railroadin," by General Electric Company.

Prof. R. C. Gibbs Speaks before Virginia Section

A joint meeting of the Section with the Hampton Roads Engineers Club was held on Feb. 28 at the Pythian Castle, Norfolk, Va. The speaker was Prof. R. C. Gibbs of the physics department, Cornell University, who gave a talk on "Atomic Energy—the Foreseeable Future." The lecture was illustrated by models to show different types of atomic structures.

W. Julian King, Speaker at West Virginia Section

On Jan. 27 at the Daniel Boone Hotel, Charleston, W. Va., the members heard a talk entitled "Personal and Professional Problems of Engineers—Common Aids and Barriers to Advancement," by W. Julian King, member A.S.M.E., director, Sibley School of Mechanical Engineering, Cornell University, Ithaca, N. Y. One hundred and forty members and guests attended. Mr. King outlined the qualifications for leadership in the engineering profession. He said that the world is full of many conflicting creeds and ideologies, but one creed is accepted by all, the creed of excellence. Taking as an example a hypothetical individual of only average intelligence and health, Mr. King described how by application to his work and by consideration of how his work fitted in with that of his fellows and his superiors, he might evolve into a leader. The subject was of such personal interest to all present, and so well presented that the discussion period which followed Mr. King's talk exceeded in length the talk itself.

Utah Section Hears Talk on the Steam Turbine

On Jan. 27 at the University of Utah, Salt Lake City, Utah, John R. Carlson, member A.S.M.E., of the Westinghouse Electric Corporation, spoke on "Modern Steam-Turbine Development." Mr. Carlson developed a clear picture of the design improvements in steam-turbine practice from its beginning to the present day. He pointed out limitations for conventional steam turbines and indicated the theoretical advantages possible with gas turbines. Sixty-nine were present.

Student Branches

University of Arkansas Branch

The first meeting of the spring semester was held in the Engineering Building on Feb. 12. Three interesting papers were presented by the following junior members: A. C. Speer, "The B-29 System of Gun Sighting;" R. C. Maxwell, "Mine Ventilation;" and Bankston Waters, "A Scientific Approach to the Study of Air Cleaners."

On Feb. 19 Ralph Burton was elected president. The last meeting of the month was held on Feb. 26. Papers on "Wood Drying," and "Radiant Heating," were given by two students, J. B. Norris and W. C. Doty.

Polytechnic Institute of Brooklyn (Day) Branch

On Jan. 7 the speaker was John I. Yellott, member A.S.M.E., director of research for the Locomotive Development Committee, who talked on the gas turbine. Mr. Yellott showed by illustrations, Newton's horseless carriage and Rumsey's jet-propelled boat, and remarked that the gas turbine and jet propulsion were old ideas. He said that the gas turbine's practical uses have increased tremendously in modern times, as was exemplified by showing its adaptation in the buzz bomb and the jet-propelled plane. One hundred and four were in the audience.

The meeting on Feb. 25 featured a talk on "Non-Destructive Methods of Testing," by Mr. Bogart, field engineer for the Magna-Flux Corporation. Using slides, the speaker explained the principles and uses of the Magna-Flux test method. This method of testing is suited only for ferromagnetic materials since a magnetic field is used to detect cracks, sharp edges, and slag deposits. The meeting was attended by 75.

Polytechnic Institute of Brooklyn (Evening) Branch

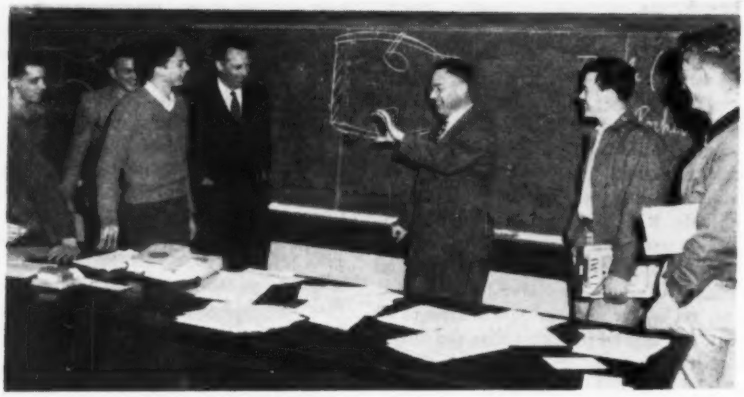
The meeting on Jan. 6 was held in Room 235. After a short business session, John Hoglund, chairman, introduced Prof. Otto Henry, member A.S.M.E., honorary chairman, who spoke on the failure of the Liberty ships. Professor Henry stressed the fact that rapid fabrication of ships was needed early in World War II because ships were being sunk at a greater rate than they could be replaced. The welded ship helped to speed production. Professor Henry explained why the first Liberty Ship broke in two. He said that steel specimens taken from ships which failed in service measured up to all specifications. One cause of failure was due to uneven loading fore and aft. The ships were not a total loss but were towed into port and repaired. Today they are still in operation. Forty-five were present.

California Institute of Technology Branch

On Jan. 27 at Kerckhoff Hall, J. R. Petersen, sales engineer for the Elliot Turbine and Power Equipment Company, was the speaker. Mr. Petersen enumerated the many rewards of his field, among which were variety of experience, lack of direct supervision, expense account, constant awareness of success or failure, and the satisfaction of winning out under keen competition. He listed the requirements peculiar to his field as liking people, health to stand up under long irregular hours, and love of games and competition of all kinds.

1947 A.S.M.E. Regional Student Conferences

Region		Host	Place	Date
I	New England	Yale University	New Haven, Conn.	May 2-3
II	Eastern	Columbia University	New York, N. Y.	May 10, tentative
III	Alleghenies	Villanova College	Philadelphia, Pa.	April 17
IV	Southern	Georgia School of Tech.	Atlanta, Ga.	April 7-8
V	Midwest	Case School of Applied Science	Cleveland, Ohio	To be announced
VI	Northern Tier	University of Minnesota	Minneapolis, Minn.	April 15-16
VI	Southern Tier	Purdue University	Indianapolis, Ind.	April 28-29
VII	Pacific N.W.	Oregon State College	Corvallis and Portland, Ore.	April 24-26
VII	Pacific S.W.	University of California	Berkeley, Calif.	May 2-3
VIII	Southern	University of Oklahoma	Norman, Okla.	April 28-29
VIII	Rocky Mountain	University of Utah	Salt Lake City, Utah	April 21-22



R. G. FOLSOM, MEMBER A.S.M.E., PUTS A POINT ACROSS AT A MEETING OF THE A.S.M.E., UNIVERSITY OF CALIFORNIA STUDENT BRANCH

The University of California Branch

The first meeting of the spring semester was held on Feb. 27 in room 104, Engineering Building. The functions of the various committees were explained and members were given an opportunity to sign up for the committees. The guest speaker was Prof. R. G. Folsom, member A.S.M.E., of the department of mechanical engineering, who gave a talk on "Rockets and Jet Propulsion." Professor Folsom covered many items which the members had studied in thermodynamics and fluid mechanics, and explained the distinction between the four sonic ranges through which missiles travel. The subject of jet propulsion was introduced by the showing of a diagram of a simple engine with a propeller on the front to create thrust. From then on the various stages of development were shown. The action of the ram-jet was explained and the talk concluded with a summary and mention of the future of rocket development. A short informal question-and-answer period followed.

University of Cincinnati Branch

The February meeting was opened by the chairman R. Lippert, with 29 members and several members of the faculty and guests present. It was announced that three papers would be presented by Messrs. Kemeny, Friedlander, and Zeidman, at the joint meeting of the branch with the Cincinnati Engineering Society. The awards are to be one-year junior membership in the A.S.M.E. and a choice of handbooks.

Clemson A. & M. College Branch

The regular bi-weekly meeting was held on Feb. 20, and presided over by P. Klinck, president. A. M. Suggs was elected treasurer. The program consisted of papers presented by two students: the first, "The Mechanical Engineer," given by Mr. Crawford; and the second, "Radar," by Mr. Treseot. A general discussion followed the talks. Twenty-eight students indicated their desire to attend the Atlanta convention to be held April 7–8. There were thirty-nine present.

College of the City of New York Branch

The first meeting of the spring semester was held on Feb. 20 in the Liberal Arts Building. A record group of 150 members turned out to hear A. R. Mumford, vice-president, A.S.M.E. Region II. With projection slides to illustrate, Mr. Mumford gave a history of the A.S.M.E., and conveyed to the audience the idea of the relation between standard of living and technological advance. We in the United States, said Mr. Mumford, having the more advanced technology, of course have the highest standard of living. He stressed the point that to be a well-rounded engineer one must be able to present any material that he has worked on, to any group, and be able to make the presentation extremely interesting. To gain such invaluable experience, he suggested that the students send in papers to the several contests held each season.

On Feb. 27 in the Technology Building, room 108, Jerome Mandel, chairman, called the meeting to order, and asked for reports of the various committee heads. The formation and function of the Metropolitan Student Branch Council was explained, and the suggestion made that the Council find out what treatment the veteran was getting in various schools. Seventy-one were present.

Colorado A.& M. College Branch

On Jan. 20 a meeting was held in the Physics Building when the branch acted as hosts to the A.S.C.E. and A.I.E.E. student branches. The program was a lecture by Dr. Louis R. Weber, head of the local physics department and the subject, "Engineering and Atomic Power." The talk gave the students an idea of the power and possibilities of atomic energy and a desire to learn more about it. The audience numbered 44.

The meeting on Feb. 3 in the E.E. building was sponsored by the A.I.E.E. who entertained the A.S.M.E. branch. The guest speaker was W. S. Pullen, sales engineer representing General Electric Company, who gave an interesting talk on the watthour meter, accompanied by a sound motion picture made at the main plant in West Lynn, Mass. Thirty were present.

Management Division, Columbia University Branch

On Feb. 6 in 314 Engineering Building, officers were elected for the spring semester as follows: E. R. Wassman, president; V. J. Magistrale, vice-president; Miss M. F. Phillips, secretary; W. Hecht, treasurer. It was decided that a news-sheet to be called "*I. E. Chatter*" would be instituted by the branch, and G. Levine and V. Magistrale were appointed to set the plans in motion. Twenty-one were present.

Cooper Institute of Technology Branch

The regular monthly meeting was held on Feb. 24 with Marvin Teitelbaum, chairman, presiding. Announcement was made of the formation of the Metropolitan A.S.M.E. Student Branch Council at which the branch will be represented temporarily by the chairman and Henry Wald, who will submit a report on the activities of the council at the next meeting. A paper entitled "Production Gaging," was given by Jack Malek, who illustrated his talk with slides, and conducted a question-and-answer period at its close. Mr. Malek described in detail the principles behind the design of standard plug and snap gages, and progressed to the uses of standard gages in actual production work. He concluded with a description of a common type of nonstandard gage, the flush-pin type, and illustrated its use in special cases of gaging stepped pieces and undercuts. Thirty were present.

University of Florida Branch

On Feb. 18 the following officers were elected for the coming semester: W. H. Loest, chairman; Robert L. Olive, vice-chairman; Evert A. Young, secretary-treasurer; Robert L. Olive, assistant treasurer. John TeSelle was elected as senior representative to the Benton Engineering Council, and T. B. Pasteur as junior representative. The new chairman appointed Harold Cherner, Monte L. Drake, and David E. Russell on the publicity committee; Harry C. Crim, Jr., on the movies committee as well as acting as field-day chairman. Twenty-two were present.

Iowa State College Branch

On Feb. 19 in room 209, Engineering Building, Hiram Brown, regional chief metallurgist for Solar Aircraft, Des Moines, Iowa, gave an interesting talk on aluminum. At a short business meeting following the program, John Forsberg and Larry Lingren were elected representatives from the mechanical-engineering department to the Engineering Councils. Eighty were present.

State University of Iowa Branch

On Jan. 8 a meeting was held in the Engineering Building and called to order by the president, L. E. Fuller. He introduced John Bullock, personnel representative of Allis-Chalmers, who told of his company's setup, and showed two films. Seventy-six were present.

The meeting on Jan. 22, featured Prof. R. M. Barnes, member A.S.M.E., who spoke on the placement system which is used for engineering graduates and alumni. After the talk a discussion was held.

University of Kentucky Branch

On Feb. 7 at a meeting in the University High School Auditorium, a contest was announced for the selection of student papers to be presented at the Regional Student Branch

A.S.M.E. STUDENT BRANCH OF MARQUETTE UNIVERSITY DURING INSPECTION TRIP, JAN. 9, 1947

Conference at Indianapolis, Ind. The writers of the best two papers are to have all traveling expenses paid on the trip, and receive an additional award of $15 each to cover all expenses. All those who submit papers are to receive an award of some kind not yet determined. For the program, a film was shown entitled "Aerodynamics," which explained the fundamentals of aerodynamics. One hundred and forty-three were present.

Lehigh University Branch

The final meeting of the fall-winter semester was held on Feb. 6 in Packard Laboratory. Dr. Thomas W. Chilton, technical director of the industrial and development engineering divisions of the du Pont Company, gave an interesting talk on "Engineering in a Chemical Manufacturing Organization." He showed how a wide variety of engineering talent is required for the solution of the many problems met in such a diversified process as chemical manufacturing, emphasizing the need in chemical organization for all types of engineers. Following the talk, a short business meeting was held, at which time K. C. Johnson, vice-president of the branch, was elected president to succeed J. J. Perrell who graduates at the end of the present semester. L. N. Luckenbach was elected vice-president; the other officers will serve until the end of the spring semester.

Louisiana State University Branch

The meeting on Feb. 25 was held in the A.S.M.E. room. J. B. Swanson, chairman, announced the following heads of committees: M. E. Patterson, program committee; E. N. Goodson, membership; W. M. Fortenberry, dance; T. F. Ruffin, calendar and meeting; R. S. Carrigan, decoration; G. J. Barousse, publicity; and S. D. Matteson, papers. Forty-three were present.

On Feb. 26 classes in the Engineering College were dismissed so that the students might attend the joint Faculty-Industry meeting, at which members of the University faculty and leaders of Louisiana industry united in a conference. As a result of the meeting, the engineering faculty learned what industry wanted of the engineering graduate student.

Marquette University Branch

On Jan. 9 the branch sponsored an inspection tour through the electric power plant at Port Washington, Wis., one of a series of sponsored tours through various industrial plants in and around Milwaukee, Wis. Forty-eight students made the trip.

On Feb. 10 in the Engineering Building, Sylvester Miller, metallurgical engineer of the Falk Corporation, gave a talk on foundry methods and castings. An inspection trip through the Falk plant is planned for Feb. 17. Thirty were present.

Michigan State College Branch

On Feb. 18 in Olds Hall an address was given by Dean C. J. Freund, member A.S.M.E., of the University of Detroit, Mich. on "Its Not in the Textbooks." From a survey of outstanding men which he conducted himself, Dean Freund pointed out the helpful little habits these men had which enabled them to get ahead in industry, and which the students, as engineers just going into the field, must possess in order to climb up the ladder of success. A short discussion period followed the talk. The largest turnout of the year, 42 members and 26 guests, enjoyed the program.

Mississippi State College Branch

At the first meeting of the spring semester on Feb. 12 officers were elected as follows: J. F. O'Kelly, chairman; Ernest Strahan, vice-chairman; James L. Coleman, secretary; Frank Manning, treasurer. A short talk was given by R. E. Cook, a student member, on "Lost Wax Casting." He discussed the processes involved in this method of casting and its various uses, and answered questions on the subject. Twenty-four were present.

Missouri School of Mines & Metallurgy Branch

At the Feb. 12 meeting the following were elected to serve for the spring semester: William C. McMillan, chairman; Elmo G. Lindquist, vice-chairman; Gerson Ginzberg, secretary; and Wilbert F. Stoecker, treasurer. Four members who are competing for the A.S.M.E. student paper award, delivered 15-minute talks. The first was given by Wm. A. Hyde who discussed "Light Aircraft Design;" the second by Eugene Lavat who spoke on "Psychological Testing;" the third by W. F. Wickizer on "Waste Heat Recovery;" and fourth, by Willis H. Harville on "Boiler and Pressure-Vessel Inspection." The talks were judged by Professors G. C. Boyer and Nelson on the basis of a standard rating form provided by the Society.

An overflow audience of 60 members and 50 guests attended the Feb. 25 meeting in Mechanical Hall, to hear George T. Nolde of the Lehman Machine Company, St. Louis, Mo., give a talk, illustrated with a technicolor movie, on the Lehmann Hydrotrol Lathe and the Hydrotol Hollow-Spindle Lathe. Mr. Nolde is an M.S.M. alumnus, class of 1935, and has been with the Lehmann Company since his graduation. Following the meeting, a spring outing was announced for May 25.

A.S.M.E. MONTANA STATE COLLEGE STUDENT BRANCH VISITS FARMERS UNION INDEPENDENT REFINERY, LAUREL, MONT.

OFFICERS OF THE A.S.M.E. STUDENT BRANCH OF THE NEWARK COLLEGE OF ENGINEERING (*Left to right:* Paul Livera, R. T. De Muth, Wm. Lieberman, James Rigassio, and Morris Schwartz

Montana State College Branch

On Feb. 12 thirty members of the branch made an inspection tour of the Farmers Union Independent Refinery at Laurel, Mont. The trip was conducted by the process engineer and took three hours. It started with the cracking plant where the raw, crude, and the heavier fractions from the other processes are cracked. The group was then taken to the polymerizing plant where the high-octane gasoline is produced. The topping unit was visited next. This unit handles 40,000 gal of crude per day. The transfer pump house contains the pumps for handling the products ready for sale. The trip served to illustrate the many uses of gages, pumps, compressors, indicators, and other machines and apparatus with which the mechanical engineer is primarily concerned.

University of Nebraska Branch

On Feb. 19 in Richards Laboratory, Gerald Jones, chairman, announced the circulation of a petition to the state legislature for an increased budget for the University. The petition is being sponsored by the University of Nebraska's veterans' organization and branch members are urged to support it. Mr. Armstrong, secretary of the A.S.M.E. Nebraska Section, introduced the speaker of the evening, David Larkin, past vice-president and fellow A.S.M.E., vice-president and general manager, Broderick and Bascom Rope Company, St. Louis, Mo. Mr. Larkin presented a certificate of award to Prof. W. L. De Baufre, fellow A.S.M.E., chairman, department of engineering mechanics, on behalf of the Society. Mr. Larkin then gave an illustrated talk on "Engineering Problems in the Manufacture of Wire Rope."

Newark College of Engineering Branch

At the meeting on Feb. 18 in room 21-L the newly elected officers were installed by the retiring chairman, Paul Livera. They are: Russell T. De Muth, chairman; James Rigassio, vice-chairman; William Lieberman, secretary; and Morris Schwartz, treasurer. The program consisted of a talk by E. C. Molina, member of the faculty, on "Probability in Engineering." In his talk Mr. Molina stressed the application of the mathematics of probabilities to industrial problems and supplemented his talk with tables, curves, and dice. Forty-five were present.

New Mexico State College of A.& M. Arts Branch

A special meeting was held on Jan. 30 for the purpose of showing a sound film sponsored by the Standard Oil Company of California, entitled "The Amazing Legacy of Rudolph Diesel." The film placed emphasis on the lubrication problems of the high-speed Diesel engines. The general response of the audience of 53 was that the film was excellent.

On Feb. 6 in the Engineering Building a sound film entitled "Magnesium—the Miracle Metal," was shown. This film illustrated the development of the metal from its initial extraction from sea water, through its final state after machining. As a result of the enterprise of the branch, the "*Roundup*," newspaper of the college, has given the branch excellent publicity.

University of North Carolina Branch

A meeting was held on Feb. 11 in Chandler Hall, and called to order by Clifford Seglem, chairman. Plans for papers to be presented at the spring convention were discussed. Mr. Reyhner of the civil-engineering department, gave a talk on the practical and economic application of the strength of materials. Fifteen were present.

Ohio State University Branch

At the Jan. 30 meeting in Robinson Laboratory, Prof. Robert Wills of the College of Law, spoke on the subject "On Being an Expert Witness." Professor Wills outlined the requirements and obligations for a professional witness as compared to those of an ordinary witness. He gave the ethical standards involved in being an expert witness as follows: (1) The matter can be discussed with the attorneys before appearance in the courtroom and in this way the witness is guided in his courtroom presentation; (2) the witness can freely admit in the court just what has been done; (3) the witness need make no effort to conceal the fact that he is being paid for the service he is rendering. Forty were in attendance.

Prof. Harry R. Nold gave a talk entitled "The Engineer and the Labor Union," at the Feb. 15 meeting in Robinson Laboratory. He discussed engineering as a profession and showed how the qualifications of an engineer fulfilled the definition of the word "profession." Fifty were in the audience.

Oklahoma A.& M. College Branch

On Feb. 10 a meeting was held in the Life Science Building. Thefirst part of the program consisted of a film on the production of a light airplane. Professor Baker, head of the mechanical-engineering department, gave a short talk on preparing an engineering paper. Prof. R. Venn, member A.S.M.E., honorary chairman, read a letter inviting the members to a joint meeting of the A.S.M.E. and the Tulsa Engineers' Club on March 3 at Tulsa. Chairman Porter urged all members to begin work on papers to be presented before the branch.

Queen's University Branch

On Feb. 3 John I. Yellott, member A.S.M.E., director of research, Locomotive Development Committee of the Bituminous Coal Research, Inc., spoke before one hundred and fifteen members and guests. His talk was "The Coal-Burning Gas Turbine for Locomotive Use."

A general meeting was held in Fleming Hall on Feb. 5. The sound motion picture "Tornado in a Box," was shown. This depicted the fundamental principles of the modern gas turbine.

On Feb. 6 the third-year section of the branch visited the nylon plant of Canadian Industries, Limited, in Kingston. Special interest was shown in the air-conditioning unit and the greater number of highly specialized machines throughout the plant.

University of Rochester Branch

At the Feb. 27 meeting in the Engineering Building, committee appointments for the new term were announced, and arrangements made for attending the A.S.M.E. Regional Student Branch Conference for Group I, which is to be held at Yale University on the week end of May 3rd. Prof. J. D. Hill, Jr., member A.S.M.E., honorary chairman, urged attendance at a meeting of the engineering department on March 3rd when the subject will be "Adventures in Research," by Dr. Phillips Thomas. The program was a talk on "Railroad Mechanical Engineering" by Robert Worbois. Thirty-three were present.

Rutgers University Branch

An organizational meeting for the spring term was held on Feb. 6. The following officers were elected: David Acker, chairman; Frank Devine, Jr., vice-chairman; Thomas Gedettis, treasurer; Mary Stillwell, secretary; Burton Brower, corresponding secretary. A general outline of plans for the activities of the branch were discussed, among them, field trips to nearby industrial plants, short industrial movies, evenin; meetings with faculty and outside speakers. Prof. Charles Bacha, junior member A.S.M.E., of the mechanical-engineering department, is faculty adviser.

University of Southern California Branch

On Feb. 20 a meeting was held in the Annex Building, attended by 33. The speaker was Paul Arnerich, junior member A.S.M.E., of the Douglas Aircraft Company, and director of the aviation division, Southern California Section. He gave an interesting talk on some design problems of aircraft hydraulic power systems.

South Dakota State College Branch

At the meeting on Feb. 5 in the Engineering Building, Tom Cruisinberry gave a very encouraging report on the outcome of the Engineers' Ball. Prof. L. L. Amidom, member A.S.M.E., gave a report on the reorganization of the A.S.M.E. Regions. This branch has been placed in Region VI. Three students presented papers; the first student, Darrel Searls, spoke on "Supersonic Speed Complications;" Leonard Willet on "Diamonds;" and Robert Nelson on "Trends and Development in Power."

University of Tennessee Branch

The second joint meeting of the A.S.M.E., A.I.E.E., A.S.C.E., and A.I.Ch.E. student branches was held on Jan. 23 in Ferris Hall. The meeting was sponsored by the Associated Collegiate Engineers Board, Martin Winfrey, chairman of the Board, acted as chairman of the meeting. The program was planned by the A.I.Ch.E. The speaker was introduced by Dr. R. M. Boarts, professor of chemical engineering at the University. He was Dr. J. J. Grebe, member A.S.M.E., director of the Dow Chemical Company, and at present at Clinton Laboratories. Dr. Grebe was present at the Bikini atom-bomb test and gave a very interesting summary of the test. A technicolor film of the test released by the Navy was shown. Two hundred and twenty-five were in the audience.

University of Texas Branch

On Feb. 3 a meeting was held in the Engineering Building. As this was the first meeting of the new semester, new financial, program, and publicity committees were appointed. Plans for a contest for program ideas was outlined by R. C. Brooks, vice-president. Prof. V. L. Doughtie, member A.S.M.E., outlined tentative plans for the Regional meeting of student branches. A committee was appointed to make plans for participation in the annual program to be presented by the Ramshorn Association. A technicolor movie entitled "Jet Propulsion," produced by the General Electric Company, was shown, dealing with the fundamental principles of jet propulsion. One hundred and eight were present.

University of Toronto Branch

A supper meeting jointly with the junior A.S.M.E. student branch, was held on Jan. 16 in Hart House. The guest speaker was M. Bushnick, general manager of the Lincoln Electric Company of Canada, whose subject was "Incentive Management." This proved to be a popular subject, as was evidenced by the extended question period which followed. A movie entitled "The River," a documentary film of the Missouri Valley Authority, was shown.

Tufts College Branch

On Feb. 19 the first meeting of the current term was held in Robinson Hall. Ivey G. Royall, president, outlined the activities that will be undertaken during the next few months. Following the business meeting, Irving E. Moultrop, honorary member and past vice-president A.S.M.E., consulting engineer, gave a talk on "Problems Confronting the Young Engineer." The speaker also gave a brief talk on "Edison and the Incandescent Lamp." Fifty-four were present to enjoy the talk.

Virginia Polytechnic Institute Branch

Seventy students, accompanied by Professors J. B. Jones, member A.S.M.E., and J. L. Jones, member A.S.M.E., inspected the Norfolk & Western Railway Shops at Roanoke, Va., on Jan. 31.

On Feb. 3 a meeting was held in Patton Hall Auditorium. Prof. C. E. Trent, member A.S.M.E., explained that it has been the custom for the Institute's Upsilon Chapter of Pi Tau Sigma to present a slide rule each year to the sophomore student who had the highest scholastic standing during his freshman year. He then presented a slide to Benjamin Partlow, the winner for this year. One hundred and eight were present.

The meeting on Feb. 10 was called to order by Otey M. Glass, president. Charlie Mease, student branch secretary, reported that the branch has about 155 members in regular attendance, 80 of whom are local members, and 75 national members. A technicolor movie, "Fundamentals of Arc Welding," produced by the General Electric Company, was shown.

On Feb. 17 a joint meeting of several of the local engineering-curriculum societies was held in Burruss Hall auditorium. E. B. Norris, member A.S.M.E., dean of engineering, introduced Ed Greggs, chief engineer of the lamp division, General Electric Company. He showed two films produced by his company, one on fluorescent lighting and the other about the P-80A Shooting Star jet engine. The audience of approximately 500 enjoyed the program.

Washington State College Branch

A joint meeting with the A.S.M.E. Inland Empire Section, Spokane, Wash., and the University of Idaho student branch was held on Feb. 15 in room 110, Mechanical Arts Building at the Washington State College. Professor Crane, who has been appointed to help co-ordinate the activities of the student branches in the Northwest, was present, and announced plans for the Regional Student Branch Conference to be held soon at Oregon State College, Corvallis, Ore. He pointed out that at that time the contest of technical papers by the students will be held, and urged each student chapter to submit two participants.

A movie and explanatory talk on "Radio Frequency Heating" was presented by Mr. Gilbert, application engineer for the Westinghouse Electric Company, Spokane, Wash. Mr. Gilbert illustrated the two methods of high-frequency heating currently being used. Forty-two were present. Following the meeting a banquet was held in the banquet room, Home Economics Building.

University of Washington Branch

The first meeting of the new quarter was held on Jan. 22 in Guggenheim Auditorium, with Ken Decker, chairman, presiding. Richard W. Crain, Sr., junior member A.S.M.E., honorary chairman, spoke briefly on student papers. He urged members to complete the rough drafts as soon as possible. A film entitled "Air Conditioning," product of the Carrier Corporation, was shown. After the meeting the members, numbering 98, were invited to go on a tour of inspection of the air-conditioning plant in Guggenheim Hall.

University of Wyoming Branch

A short meeting was held on Feb. 13 to discuss plans for the coming A.S.M.E. convention in Salt Lake City, Utah. The members then adjourned to the oxide division, of the Monolith Portland Midwest Company. They were guided through the plant by Duncan Williams, chief chemist of the company, who explained the plant's physical and chemical processes. Forty-five made the trip.

Yale University Branch

The first meeting of the second semester was held on Feb. 10, and opened by Vincent W. Creedon, chairman, who introduced discussion of the A.S.M.E. Regional Student Branch Conference for New England and Upper New York, which is to be held at Yale this spring. Bronis R. Onuf, honorary chairman, brought up the subject of student papers, and plans were made to present several at the next meeting. A movie, supplied by the Stokes Machine Company, on automatic plastics-molding machinery, was shown. Thirty were present.

A.S.M.E. Sections

Coming Meetings

Anthracite-Lehigh Valley: April 24. Pottsville, Pa., at 8:00 p.m. Subject: "Labor and Management Relations," by William Naden, director of employee relations, Standard Oil Company of New Jersey.

Atlanta: April 7–8. Atlanta-Biltmore Hotel. Regional Administrative Conference; representatives of all Sections in A.S.M.E. Region IV will be present.

Baltimore: April 12. Navy Experiment Station, Annapolis, Md., at 9:30 a.m. Inspection trip to the Navy Experiment Station. Speakers: Admiral David H. Clark, superintendent, Navy Experiment Station, and Admiral Earl W. Mills, chief, Bureau of Ships.

Boston: April 24. Commander Hotel, Cambridge, Mass., at 8:00 p.m. Eugene W O'Brien, president, A.S.M.E., has promised to be the speaker at this meeting.

Colorado: April 11. Ladies' Night Meeting. Subject: "A Discussion of Observations of the Industrialization and Application of Engineering Developments in Africa and the Middle East," by Richard S. Nelson manager, export division, Gates Rubber Company, Denver, Colo.

Fairfield County: April 17. Hotel Barnum, Bridgeport, Conn. Dinner at 6:30 p.m.; Lec-

ture at 8:00 p.m. Subject: "Home Freezers and the Home Freezing of Food," by Dr. Donald K. Tressler.

Ithaca: April 28. Arlington Hotel, Binghamton, N. Y., at 6:30 p.m. Subject: "Personal and Professional Problems of Engineers," by W. Julian King, director, Sibley College, Cornell University, Ithaca, N. Y.

Metropolitan: April 10. Woman's Auxiliary. Trip to United Nations at Lake Success. Chartered bus leaves Herald Square Terminal, 59 West 36th St. at 10:30 a.m. Send reservations to Mrs. Carl F. Kayan, 425 Riverside Drive, New York, N. Y.

Minnesota: April 28. St. Paul Hotel, 9:30 a.m. Regional Administrative Conference, representatives from all the Sections in Region VI will be present.

New Haven: April 9. Dinner at Ceriani's Cafe Mellone, 6:30 p.m.; Meeting at the United Illuminating Company auditorium, 8:00 p.m. Subject: "Personal Flying," by W. T. Piper, president, Piper Aircraft Corporation, Lock Haven, Pa.

New London: April 17. Mohican Hotel, 8:00 p.m. Subject: "Electron Tubes and their Application in Industry," by Herbert L. Kraus, assistant professor, Yale University, New Haven, Conn.

Ontario: April 10. Page Hersey Tubes, Ltd., Welland, Ont., Can. Visit to the pipe plant.

Pittsburgh: April 22. Pittsburgh Mechanical Engineering Conference. The program includes two simultaneous sessions in the morning and two in the afternoon, with President E. W. O'Brien as dinner speaker in the evening. The sessions are as follows: Materials Handling Symposium; Management Session; Power Plant Design; and Solid and Liquid Fuels, Lubricants, and Lubrication.

Schenectady: April 10, Stevenson Memorial Night. Subject: "Engineering Education," by M. M. Boring, General Electric Company, Schenectady, N. Y.

Washington: April 10. Potomac Electric Power Company auditorium, 10th and E. Sts., N. W., Washington, D. C., 8:00 p.m. Subject: "Some Practical Aspects of Automatic Control," by W. H. Steinkamp, field sales manager, Brown Instrument Company.

Western Massachusetts: Hotel Wendell-Sheraton, Pittsfield, Mass., 6:30 p.m. Joint meeting with the Engineering Society of Western Massachusetts. Subject: "Plastics" (speaker to be furnished by the General Electric Company). There will be an inspection tour through the G. E. Company plastics plant in the afternoon.

West Virginia: April 28. Daniel Boone Hotel, Charleston, W. Va., at 8:00 p.m. Subject: "Recent Boiler Design Practice," by W. H. Rowand, The Babcock & Wilcox Company, New York, N. Y.

Annual Collegiate Ball

THE Junior Group of the A.S.M.E. Metropolitan Section and the student branch of New York University have joined forces to sponsor the 1947 Annual Collegiate Ball.

Junior members, especially those who are comparative newcomers to New York, are invited to join in the fun.

The ball will be held April 26, 1947, on the campus of New York University, University Heights, New York, N. Y. Shep Fields and his orchestra will furnish the music. Tickets are $3 per couple for students and $4 per couple for members and guests. The Ball will be semiformal.

For tickets send check or money order to A.S.M.E. Collegiate Ball Committee, 29 West 39th Street, New York 18, N. Y.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., which is under the joint management of the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to members and is operated on a co-operative nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrants whose notices are placed in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available to members of the co-operating societies at a subscription of $3.50 per quarter or $12 per annum, payable in advance.

New York 8 West 40th St. | **Chicago** 211 West Wacker Drive | **Detroit** 109 Farnsworth Ave. | **San Francisco** 57 Post Street

MEN AVAILABLE[1]

MECHANICAL ENGINEER, graduate, 30, married. Experience in aeronautical engineering, sales research, and development. Desires position in service, sales, or operating engineering. Now employed in Maryland. Eastern seaboard preferred. Me-153.

CHIEF ENGINEER—PLANT ENGINEER, chemical or food processing. Well-rounded experience both as an engineer and executive. Installed preventive-maintenance programs. Co-operated with production to reduce costs and increase yield. Me-154.

CHIEF ENGINEER and acting general manager, 45 years old. Steam and gas turbine, compressor, supercharger, jet-propulsion, and air-conditioning experience. Now employed; considering change. Me-155.

SALES MANAGER OR SALES ENGINEER; Carnegie Tech., 1943; 42, family; 16 years' sales, sales administration with small, medium, large firms. Gas, liquid meters, pressure controls, gages, instruments, plumbing goods, valves, pumps, steel castings, etc., sold to utilities, industrials, municipalities, jobbers, contractors, architects, etc. Me-156.

EXECUTIVE ENGINEER. Twenty years' experience including administration and consulting in vice-presidential capacity, director of engineering, supervision of operations, development, design, and construction. Broad familiarity chemical engineering and process industries. Me-157.

MECHANICAL ENGINEER, junior, 33, B.M.E. Two years' industrial experience as methods engineer and quality-control man on dimensional variations. Interested in starting anew in company with training program. New York, Connecticut, Pennsylvania, or like vicinity. Me-158.

MECHANICAL ENGINEER, B.S.M.E., 5 years' varied experience in sales and manufacturing. Four years' responsible supervision. Knowledge accounting including costs. Desire position as liaison engineer or assistant to executive in New York, N. Y. $5000. Me-159.

MECHANICAL ENGINEER; B.S.M.E., electrical experience, over 10 years' structural and mechanical-device design, development, material ordering, supervision of parts manufacture, construction and test of pilot models. Me-160.

INDUSTRIAL ENGINEER, single, young, ambitious; B.S.M.E. Purdue; M.S.I.E. Columbia in June. One year's experience in machine-tool operation and setup. Interested in production phase in mechanical industry. Location salary open with opportunity. Me-161.

MECHANICAL ENGINEER. Year and a half experience in heat-transfer research by electrical analogy. Possesses executive ability. Desires responsible position in East. Available immediately. Me-162.

LABOR RELATIONS MAN. B.S., M.E., LL.B. Licensed professional engineer. Member N. Y. bar; 18 years' diversified industrial experience. Thorough knowledge labor law. Commander USNR, director industrial relations, assistant to president, etc. Me-163.

MECHANICAL ENGINEER, B.S.M.E., age 27; two years' research, design, and testing pumps, hydraulic systems, and accessories. Two years' marine piping and installations. Two years' installation, maintenance, repair of electronics gear. Me-164.

[1] All men listed hold some form of A.S.M.E. membership.

Mechanical Engineer, four and one half years' varied experience including testing, tool design, mechanical design, and engineering liaison, in marine, manufacturing, and aircraft fields; desires position involving development of machinery. B.S.M.E., Penn. 1940. Me-165.

Mechanical Engineer, graduate, age 32. Eight years in electric cleaners, rubber tires, and aircraft manufacturing. Experience layout, testing, contract sales, liaison. Prefers position in traffic, industrial engineering, or office sales. Me-166.

Mechanical Engineer, Graduate M.E., licensed, age 30, 7 years' experience in test installation, servicing, development, and design of heavy machinery and special equipment. Know centrifugal pumps and compressors, Reliable energetic. Me-167.

POSITIONS AVAILABLE

Mechanical Engineer with ferrous metallurgical experience, preferably in tool and die fields, to design new equipment and supervise installation for manufacturer of pointed wire products such as card, pins, etc., for textile industry. $5000-$6000 year. Northern New Jersey. W-8434.

Associate Professors, (*a*) Associate professor of mechanical engineering to teach machine design and vibrations. Should have some industrial experience; some teaching experience desired. (*b*) Associate professor of mechanics to teach courses in theoretical and applied mechanics, fluid mechanics, and stress analysis. Some industrial experience desired. Salaries to $5000. Upstate New York. W-8442.

Glass Technologist, 30-40, preferably with mechanical-engineering training and at least 5 years' glass-working experience, to improve manufacturing process for forming and annealing glass tubing. $3600-$4200 year. New Jersey. W-8598.

Chief Inspector, 30-40, mechanical graduate preferred, with at least 10 years' experience in light-equipment manufacturing, to take charge of inspection for office-equipment manufacturer. $5000-$6000 year. New England. W-8604.

Mechanical Engineer with experience in steam-power plants, installing and maintaining boiler auxiliaries. Design experience on valves and instruments required. Working knowledge of thermodynamics essential. Southwestern Pennsylvania. W-8615.

Instructor interested in teaching industrial engineering in one of the larger universities. Upper New York State. W-8624.

Designers, mechanical, 35-50, to design parts of paper and pulp mills. Design work will incorporate welfare and safety of others, cost, and conservation of materials. Will be responsible for equipment while supervising actual building. Must furnish own drafting instruments. $4000-$5000 year. New Hampshire. W-8635.

Management Engineer, 30-35, preferably mechanical graduate, with broad basic industrial experience, including actual production experience as responsible factory department head, to survey and resolve operating problems into recommended solutions from management viewpoint. Working knowledge of cost and general accounting is desirable to interpret profit and loss and balance sheet to the shop and vice versa. Position affords opportunity to correlate finance, merchandising, insurance, etc. Some traveling, $5000-$6000 year. New York, N. Y. W-8646.

Manager for industrial department of Chamber of Commerce, qualified to head research and statistics and do all the promotion work in connection with promoting city's industrial growth. Any experience in the South would be beneficial. $5000-$6000 year. South. W-8657.

Mechanical Engineer, not over 50, for maintenance and improvement of floating plant consisting of seagoing hopper dredges, derrick boats, Diesel tugs, steam tugs, and other miscellaneous floating-plant equipment. Other equipment includes one lock, electrically operated; machine shop, miscellaneous shop, automotive equipment. $4149-$4900 year. Headquarters, Upper New York State. W-8663.

Chief Plant Superintendent who will supervise the plants' superintendents, in company's plants, mostly engaged in manufacture of very heavy equipment. Will be consultant on manufacturing methods, machinery, tools, plant layout, etc. $10,000-$12,000 year. Headquarters, Ohio. W-8674 (*b*).

Office Engineer, not over 35, experienced in instruments, valves, time and pressure-control equipment, etc., will act as liaison between engineering and sales departments in home office. $7500 year. Western New York. W-8693.

Mechanical Engineer, graduate, with at least 6 years' experience including some work in the electrical field, to carry out independently assignments with responsibility for review and analysis of technical material; reviewing the design and/or designing equipment for such projects as 1000-bed hospitals, multiple-purpose dams, pump houses, control houses, and other related flood control and maintenance projects. $5905 year. Upper New York. W-8711.

Mechanical or Electrical Engineer, graduate, with at least 1 year's industrial experience involving machinery arrangements, steam-power generation and utilization, for consulting-engineering firm. Write stating training, experience, and salary desired. Midwest. W-8720-C.

Instructors of industrial engineering, graduates with 1 to 4 years' industrial experience. $4200 for eleven months. Housing available. Positions open June or September, 1947. Oklahoma. W-8727.

Sales Engineers, 35-50, preferably graduate mechanical engineers, with ten years' experience in heating and ventilating. Should have had good sales or executive experience; some experience in handling men. Also engineers with fan and blower experience for sales and marketing. Considerable traveling. $6000-$7500 year. Vacancies in New York, N. Y., Detroit, Mich., Cleveland, Ohio, and Illinois. W-8734.

Senior Engineers: (*a*) Servomechanisms, hydraulic, pneumatic, electric. (*b*) Gyro mechanisms and other instrumentations. (*c*) General mechanical component design airborne radar. Several years' commercial experience in one or more of above, good educational background. Large guided-missile program. All phases, study, research, development, product design for production. Positions offer permanence, top salaries, and opportunities for increased responsibility for men who can produce. Location. Massachusetts. B-1199.

Project Engineers (3). (*a*) One to head-up research and development on hard boards made into sheets. Employer located inMinneapolis, Minn., and plant at International Falls. Company building new lab at this point. Position is permanent; $6000 year or more. (*b*) One to develop and improve present products consisting of asphalt-containing board, as well as develop new products in this field. Position is permanent; $5000 year or higher. (*c*) One familiar with paper and paper-pulp field with some ideas on improving present product and creation of new products. The company makes kraft, newspaper, and publication grades by the sulphite and sulphate cooking processes. Now installing a bleaching plant. $6000 or more. R-4049.

Candidates for Membership and Transfer in the A.S.M.E.

The application of each of the candidates listed below is to be voted on after April 25, 1947, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

Re = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Fellow, Member, Associate, or Junior

Akins, D. A., Ditchling, Sussex, England
Anderson, Albert F., Denver, Colo.
Anderson, Carl E., Wellesley, Mass. (Rt & T)
Andrews, G. N., Wood River, Ill.
Applegate, John E., Columbus, Ohio
Archibald, William D., Elizabeth, N. J. (Rt & T)
Ashton, Arnold T., Kansas City, Mo.
Baldwin, Carroll Wesley, Philadelphia, Pa.
Blanding, Howard C., Douglaston, N. Y.
Blessin, Fred K., Moline, Ill.
Brearley, William H., Jr., Philadelphia, Pa
Breed, Allen, Erie, Pa.
Brown, Herbert K., Bethlehem, Pa.
Cambel, Ali B., Iowa City, Iowa.
Cave, C. M., Jr., Indianapolis, Ind.
Clark, Ernest A., Jr., Bridgeport, Conn.

Crouthamel, Merrill, Boyertown, Pa.
Cummings, Richard A., North Troy, N. Y. (Rt & T)
Daley, Paul H., Union City, Conn.
Das Gupta, B. B., Jamalpur, India
Dean, Joseph F., Bloomfield, N. J.
De la Cruz, F., New York, N. Y.
Des Jardins, Paul R., Buffalo, N. Y.
Donlon, Grover Peter, Chicago, Ill.
Douglas, L., Johannesburg, S. A.
Draughon, Charles R., Jr., Baton Rouge, La.
Dunbar, Roy A., Tulsa, Okla.
Durr, Henry Hubert, Detroit, Mich.
Early, William G., Binghamton, N. Y.
Ebert, Herman G., Philadelphia, Pa.
Edwards, J. G., Peoria, Ill.
Evans, Robert A., Roosevelt, N. Y.
Ewing, Robert W., Birmingham, Ala.
Falk, K. H., Columbia, Conn.
Feigenbaum, A. V., Schenectady, N. Y.
Francisco, A. L. R., Garden City, N. Y.
Freneau, Philip, Greensburg, Pa.
Giese, C. A., New Martinsville, W. Va.
Glenn, Terry, Bridgeport, Conn.
Goalwin, Harry A., Northport, N. Y. (Rt)
Gwiazdowski, A. P., Angola, Ind. (Rt)
Hartshorn, Stanley D., Wayne, Pa. (Rt & T)
Hoffbauer, Carl F., New York, N. Y.
Hoober, Daniel, Washington, D. C.
Housley, J. Elmer, Alcoa, Tenn.
Hull, Henry E., Columbus, Ohio
Humphrey, Stanley M., Evanston, Ill.
Keeler, Forrest J., Burbank, Calif.
Kewley, Robert P., Denver, Colo.
Kimberling, William R., Charleston, W. Va.
Kirk, John Leston, Vernon, Calif.
Koch, Harold V., Peru, Ind.
Kuhn, Edward J., Cincinnati, Ohio (Rt)
Leason, Fred L., Jr., Chicago, Ill.
LeCoff, Jesse, Philadelphia, Pa.
Martin, Ronald J., Elizabethton, Tenn.
McClune, James W., Salt Lake City, Utah
McIntosh, William, Jr., Savannah, Ga.
Morgan, Ralph P., Jr., Durham, N. C.
Morris, J. H., Selah, Wash.
Morris, John Marshall, Jeffersonville, Ind.
Naylor, Edward G., Hinsdale, Ill.
Nishkian, Martin A., Long Beach, Calif.
O'Brien, Robert A., New York, N. Y.
Oetjen, J. Edward, North College Hill, Ohio
Oza, Hasmukh P., Gadhada, Swami's, India
Parekh, Natwar, Ann Arbor, Mich.
Peal, Edward J., Dover, N. H.
Peterson, Robert M., Chicago, Ill.
Pinger, Edmund G., Freeland, Pa.
Radow, Himan, Seattle, Wash.
Richardson, Leon F., Los Angeles, Calif. (Rt & T)
Ritterbusch, Walter H., Jr., Tulsa, Okla.
Roberts, Roy L., Dayton, Ohio
Ross, Franklin L., Wichita, Kansas (Re)
Rudich, A., Mexico City, D. F.
Schmidt, Wilhelm R., Binghamton, N. Y.
Scott, Elmer F., Jr., Chicago, Ill.
Shanks, E. Chat, Baltimore, Md.
Shartle, Robert A., Short Hills, N. J.
Sheltman, C. Payne, Staten Island, N. Y.
Sherwood, Robert S., Ames, Iowa
Skoog, A. Warren, Bridgeport, Conn.
Slattery, R. O., Glendale, Mo. (Rt & T)
Slomer, Joseph J., Chicago, Ill.
Smith, Alexander M., Kent, Ohio
Smith, J. Winston, Kingsport, Tenn.
Spangler, John I., York, Pa. (Rt)
Stevens, Durward V., Milwaukee, Wis.
Stevens, John A., New York, N. Y.
Suman, Robert W., Manoa, Havertown, Pa.
Swanston, W. A., Hudson, Ohio
Tabor, Warner H., Uxbridge, Mass.
Todd, John, St. Louis, Mo.
Tolhurst, F. H. A., Berbice, British Guiana
Tribble, Joseph James, Savannah, Ga.
Tschappat, S. P., Tulsa, Okla.
van der Arend, P. C., Dobbs Ferry, N. Y.
Verrando, Mrs. Ornella T., Flushing, N. Y.
von Mehren, O., Lorain, Ohio
Warshal, Morris, Hazleton, Pa.
Weaver, Frank W., Lynn, Mass.
Wheelock, Ray N., Wilmington, Del.
White, Theodore R., New York, N. Y. (Rt)
Widness, John E., Washington, D. C.
Williams, R. C., New York, N. Y.
Wilson, Clyde J., Pasadena, Calif.
Wise, Milton A., Los Angeles, Calif.
Womack, C. Carnan, Sr., Youngstown, Ohio
Woodhull, Elliot H., Rochester, N. Y.
Wyant, John R., Atlanta, Ga.
Young, Jay Olney, Chicago, Ill.

CHANGE IN GRADE

Transfers to Fellow

Le Tourneau, R. G., Peoria, Ill.
Smith, J. F. Downie, Ames, Iowa
Waller, C. R., Trenton, N. J.

Transfers to Member

Argust, Frank F., North Hollywood, Calif.
Avakian, Arra Steve, York, Pa.
Brenneke, Herman J., College Point, N. Y.
Bridge, Theodore E., Wilmington, Del.
Burkett, William J., Sarasota, Fla.
Burns, Rodney C., Syracuse, N. Y.
Carr, Robert E., Alhambra, Calif.
Conklin, Robert M., Worthington, Ohio
Earl, Thomas C., Savannah, Ga.
Gibb, Joseph F., Niagara Falls, N. Y.
Gutsch, Peter J., Temple City, Calif.
Huffman, Robert L., Chicago, Ill.
Keller, Leonard F., Metuchen, N. J.
Kiernan, Francis R., Canastota, N. Y.
Palmer, John Hambleton, Bridgeport, Conn.
Patch, Alfred E., New Haven, Conn.
Richards, William N., Clarks Summit, Pa.
Sexton, Joseph Matthew, Newark, N. J.
Silverman, Leslie, Boston, Mass.
Wilson, Rosser L., Mahwah, N. J.
Wise, Max R., Tulsa, Okla.

Transfers from Student Member to Junior 85

Necrology

THE deaths of the following members have recently been reported to headquarters:

Berggren, Karl G., February 13, 1947
Dinges, Rawlston M., December 31, 1946
Faile, E. Hall, February 21, 1947
Germer, Fred W., January 17, 1947
Henderson, John R., October 25, 1946
Hunter, James D., January 6, 1947
Kraft, Lester L., January 16, 1947
Matlock, Chauncey, January 30, 1947
Mealand, Alfred, January 24, 1947
Porter, H. Hobart, February 9, 1947
Walkem, George A., December 13, 1946
Weinstein, Alexander, February 19, 1947
Young, Everett G., January 10, 1947

Metropolitan Student Branches Plan Council

REPRESENTATIVES of eight A.S.M.E. student branches, situated within or near the New York Metropolitan area, met at headquarters on Feb. 28, 1947, to lay plans for a Metropolitan Student Branch Council to promote interchange of information on speakers and programs, facilitate joint meetings, and generally to help students in their transition to junior member status in the A.S.M.E.

The following schools were represented: College of the City of New York, Columbia University, The Cooper Union, Polytechnic Institute of Brooklyn, New York University, Pratt Institute, Rutgers University, and Stevens Institute of Technology.

W. L. Betts, member A.S.M.E., is serving the group in an advisory capacity.

A.S.M.E. Transactions for March, 1947

THE March, 1947, issue of the Transactions of the A.S.M.E., which is the *Journal of Applied Mechanics* contains:

TECHNICAL PAPERS

- Determination of the Natural Frequencies of the Bending Vibrations of Beams, by A. I. Bellin
- The Design of Vibration-Isolating Bases for Machinery, by C. E. Crede and J. P. Walsh
- Static-Load Tests on an Aircraft Gas Turbine to Simulate Loads Produced by Rapid Plane Maneuvers, by A. W. Brunot and W. B. Goddard
- The Initiation and Propagation of the Plastic Zone in a Tension Bar of Mild Steel Under Eccentric Loading, by Julius Miklowitz
- The Initiation and Propagation of the Plastic Zone in a Tension Bar of Mild Steel as Influenced by the Speed of Stretching and Rigidity of Testing Machine, by Julius Miklowitz
- On the Collapse of a Hemispherical Cavity Seated on a Surface, by H. P. Oza
- Geometrical and Metallurgical Changes in Steel Surfaces Under Conditions of Boundary Lubrication, by B. W. Sakmann
- Maximum Performance of Helical Springs, by E. I. Shobert, 2nd
- Bending of Clamped Plates, by W. B. Stiles
- The Influence of Size on the Brittle Strength of Steel, by N. Davidenkov, E. Shevandin, and F. Wittman

DISCUSSION

- On previously published papers by R. C. Binder and J. E. Busher; S. J. Dokos; C. W. MacGregor and J. C. Fisher; D. R. Meier and J. C. Rhoads; J. E. Pochapsky and W. J. Mase; H. Poritsky; A. W. Rankin; A. C. Hagg; and E. R. Van Driest.

BOOK REVIEWS